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# The Railway and Locomotive Historical Society,

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In presenting this bulletin to our membership, which is the last due them for the extended memberships of 1945-6, we take pleasure in calling your attention to the contribution on the Pacific type of locomotive by Mr. Paul T. Warner. To those of us that have a few gray hairs, or none, and who easily recall the American type at the head of our fast trains, we have lived to see the birth and probably the most extensive use of this type in this country. It was the logical development from the Ten-wheeler, but the use of trailing wheels permitted a larger firebox and it soon was the standard type for passenger service and, on some roads, for freight service also. But this type too, has given way to the Hudson, Mountain and 4-8-4 types and it is doubtful if they will be built in any great quantities tho' it has not outlived its usefulness. There have been some fine examples of this type built in this country and we are indebted to Mr. Warner for his interesting and valuable contribution.

We welcome back to our columns Mr. Gilbert Kneiss with his careful preparation on the locomotives built by the Union Iron Works in San Francisco, Cal. The name has generally been associated with shipbuilding, especially the famous "Oregon" of Spanish-American War fame but the history of their locomotive products is decidedly new and well worth recording. Mr. Charles B. Chaney has added another of his

valuable contributions on the old Class "R" locomotives of the Pennsylvania R. R. and Mr. John B. Kendall has contributed some interesting facts on the Hardwick & Woodbury R. R. of his native state.

Through the kindness and suggestion of Mr. R. L. Eddington, we are reproducing the paper of Dr. Edmund C. Burnett. It is something of a digression from our usual form but for sheer local color and boyhood recollections from a section that has had but little space in our columns, I'm sure that our members will enjoy it. I daresay that nearly all of us had our favorites, like "Old Buncombe" in one form or another.

The paper read before our New York Chapter by Mr. Fred P. Huston is one that may well provoke some thought on the part of all of us. Whether the steam locomotive is supplanted by other forms of motive power through the efforts of John L. Lewis or others, that remains for the future. The expression of the author that our steam locomotives should be better maintained is one in which we can all concur. The steam locomotive has taken a pile of abuse by means of overloading and lack of maintenance. If the same policy is pursued towards the electric or diesel it will definitely spell locomotive failures and excessive maintenance costs. But there is one thing that comes up—what about the sacred motive power standards of the many roads? For years now, our railroads have had their own standards and from the way some motive power men talk, one might assume that the locomotives of other roads would not even turn a wheel on their road. During World War I, the U. S. R. A. worked out some fine designs of certain types of locomotives, especially the Pacific and Mikado types. Some roads incorporated these designs in their newer power, others discarded them altogether but World War II saw the O. D. T. adopting similar measures for some of our recent orders. That there can be a definite saving along these lines, is well known, but the individual standards have always prevented their adoption. Now comes the diesel motor, right off the production line, take your choice in the service you want and the color scheme in the matter of decoration. If this is so, and the diesel motor is a success, then the sacred standards of the individual roads must go into the discard and, in so doing, must come the confession that most of them were ill founded and very costly, which many of us knew. That there is room for further improvement along these lines for the steam locomotive, is well known, whether it can or will be adopted, is something for the future. Mr. Huston's paper is worthy of serious study and consideration.

## Cover Design

Through the kindness of Mr. Kuhler and the work of Mr. Aurion Proctor, one of his artists, we are indebted for our cover design. It represents the heaviest known Pacific type locomotive built—No. 602 on the C. St. P. M. & O. Ry. These locomotives have performed remarkably well on that road, handling unusually heavy trains and their dimensions have been included in the tables of Mr. Warner. We deeply appreciate the kindness of Mr. Kuhler and Mr. Proctor in furnishing us with this fine sketch.

# The Railroad Comes To Big Creek[1]

By Edmund Cody Burnett

The French Broad River is a wayward stream, and, through much of its course, a frolicsome one withal. From Asheville, North Carolina, to Wolf Creek, some three miles within the Tennessee border, the river turns and twists, leaps and cavorts, chatters and warbles, seldom quiet, seldom silent. The numerous "horseshoe" bends give the modern traveler by train the thrilling experience of seeing through his window the engine that draws his train rushing in the opposite direction. If, along this course, you speak the river's name, that rollicking stream seems to laugh in your face: "Broad, am I? Ho! Ho!"

And the channel is scarcely wider than the river. Once, though here and there with difficulty, room was found along the northern bank for a turnpike. But along came the railroad and stole away the turnpike. The County of Madison did indeed find a strip, narrow and of short stretch, on which to establish its county seat;[2] then came the railroad, and it was forced to use for its passage the one narrow street or else to borrow from the river. It borrowed from the river. The channel is, in fact, a deep gorge, which ages of corrosion have carved through the hills. Accordingly the banks are high, steep, wooded slopes or precipitous cliffs. The picturesqueness, the charm, of the French Broad along this gorge have become proverbial.[3]

At Wolf Creek the hills begin to recede, and, for some ten miles, the river sweeps in wider curves and with gentler current through an open valley of relatively broad and fertile fields. Then, at what is locally known as "The Falls," the river is once again crowded into a narrow gorge between twin heights of the Stone Mountain range, the one that has preempted the name Stone Mountain on the south, and Neddy's Mountain, on the north.

At Del Rio, midway between Wolf Creek and "The Falls," the traveler by train may catch a fleeting glimpse—though few there be that find it—a glimpse only of a lateral valley stretching away to the south and rimmed by high mountains. On the left, the broad, sym-

[1] This paper, in part and in a somewhat variant form, was read before the Palaver Club of Washington, D. C., November 8, 1940.

[2] An example of the crude, rough jokes with which Tennesseeans and North Carolinians were wont to bandy one another is a conundrum once current in our valley: "Why can't they sew shoes in Marshall?" (This, be it understood, was in a day when shoe cobblers, a species now all but extinct, abounded throughout our mountain country.) The answer was: "Because there isn't room between the mountains to draw the threads."

[3] An incident in this writer's experience may be the proverbial exception that proves the rule. I had taken a train for Asheville and, just when the train had entered the gorge above Wolf Creek, I went into the smoking compartment. There I observed a man with his head thrust well out the window, intently viewing the landscape. On hearing me enter he withdrew his head and fixed upon me a glare of anxious bewilderment. "Why in Hell," he besought me, with unfeigned earnestness, "did God'lmighty pile up these damned old hills here?"

metrical dome of Round Mountain seizes the eye and reluctantly yields it. Walnut Mountain, though less conspicuous, stands hard by, arm in arm, as it were. On the other side of the valley is Laurel Mountain, an immense "hog-back" pile, looming sheer above the upper valley. Beyond is magnificent Snow Bird, though scarcely visible from the floor of the valley. At the farthest rim of vision is Max Patch Mountain, the highest in all that region (nearly 5000 feet), but, as viewed from the valley, it lacks the stark individuality possessed by several of its neighbors. Max Patch Mountain, by the way, is the only one among the multitude of high mountains in the southern Appalachians that offers at its topmost height a sufficiently broad and level space for the landing of airplanes.[4]

This is the valley of Big Creek—big enough indeed, where it joins the French Broad, to deserve the title of river. The Cherokees or their predecessors, who once had a village at the mouth of the creek[5] and some sort of fort or lookout on a neighboring height, doubtless had a more euphonious, if not also more romantic, name for the creek; but our pioneer forebears, being above all else a practical people, with little bent for the romantic and with no admiration whatever for anything Indian, if they ever knew the name, discarded it with disgust. Actually, except for the last quarter mile, Big Creek is two big creeks, each fed by many forks, prongs, and branches. The beginnings of the two main creeks are not very far apart in the high mountains to the south, but, whilst one of them plunges headlong down the mountain gorges and sweeps directly through the valley, as if in haste to reach the river, the other takes a roundabout and leisurely course of many miles.

The traveler's hurried glimpse at Del Rio of the receding valley could scarcely be other than indefinite and unsatisfying. If therefore

[4] Doubts still hang around the origin of the mountain's curious cognomen. My uncle Jefferson Burnett, who owned a tract of land on Rich Mountain, adjoining Max Patch, once confidently explained to me the origin thus: One Mack Fox cleared the first patch of land on the mountain, whence the mountain, theretofore without a name, became known as "Mack's Patch Mountain." Subsequently "Mack's" became transformed into "Max." One reason for doubting this and other similar explanations is the fact that Arnold Guyot, in his notes of surveys in the years 1856-1860, uses the name Max Patch in a manner to suggest that it was then the common appellation. (See the *North Carolina Historical Review*, July, 1938, pp. 263, 276.) This does not necessarily contradict my uncle's explanation, for, when I used to see Mack Fox in the 1870's, he must have been very old. At least he was as baldheaded as the prophet Elijah.

[5] The site of the prehistoric village is almost directly in front of the Southern Railway depot. As a boy I gathered many a pocketfull of arrowheads and broken pottery from that soil; and I have done a little gleaning there in more recent years. Some skeletons also—supposed to be Indian skeletons—were unearthed when the railroad was graded along the edge of the site. Mr. John A. Jones tells me that once he wandered down there to watch the men at work grading, and his eye fell upon one or more skulls perched atop a rail fence that ran along the river bank. His eye also fell upon a big hornet's nest near one of the skulls. Unable to resist the temptation he threw a stone at the hornet's nest, but hit one of the skulls and smashed it. Thereupon the finder of the skull threatened him with a whole troup of Cherokee warriors, who would return in spirit and skin him alive if they caught him. Fast as his legs and a canoe would carry him he put the river between him and the violated skull.

he will come again and find a right coin of vantage, he may obtain a view of pervasive charm, ofttimes an alluring vista. Moreover, he will discover that he has had not even a glimpse of the whole valley. For, barred from view at the railroad or the river's brim by a wall of knobs and peaks that ascend in orderly succession from the valley to the lofty peak called Stone Mountain, is the valley of that other Big Creek, a valley opening broadly to the westward and dominated at the apex by Hall's Top, monarch of the Stone Mountain range, and commanding also the magnificent expanse to the west of that range.

Such in brief is the physiographical setting of that Appalachian bull pen known of old as Big Creek,[6] but wearing now, oddly enough, the Hispanic name of Del Rio. (Truth to tell, no Spanish or Mexican toreador ever sported there with any bull, nor is it of record that, of the many who have sought there the fountain of youth, any were of the Hispanic race.) The human landscape, the story of the people who have dwelt there, is another and more engaging story, indeed several other stories.

In these latter years, if the attention of the passer-by has been drawn at all to Del Rio and its environs, probably it has been only to observe the great stacks of lumber and the huge piles of acid wood and pulp wood and maybe also of tanbark that lined the sidetrack. For these products of the forest have for many years been the valley's principal exports. Otherwise, except for the glimpse up the valley, this straggling hamlet, lazily sprawled and seeming to drowse, has offered little to induce more than a passing glance.[7]

Yet there was a time when this opening in the mountain wall was a sort of focal point for three phases of industry and commerce. Through it, as through the mouth of a funnel, poured the stream of live stock, hogs in particular, that for well nigh a century flowed annually out of East Tennessee and parts of Kentucky to the Carolinas and parts of

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[6] Although the stream (with its two main "forks," each having multitudinous "prongs") that flows into the French Broad at that point has (not ungrumblingly) borne the name Big Creek from the days of the early settlers, it was not until 1868, when the railroad thrust its nose into the valley, that the name was plastered on both the station and the post office. From 1852 to 1860 there had been a post office two and a half miles away bearing the classic name CATO (wherefore Heaven only knows); and then until 1868 folks got their mail at Parrottsville, eight miles to the north. For a round score of years (1868-1888), railroad station, post office, church, missionary society, sewing circle, literary club—and all the rest, singly and collectively—stumblingly plodded along, with BIG CREEK loaded on their backs and clawing at their vitals. And all this by virtue of the fact that the post office Big Creek in Shelby County had been wiped from the slate only a few months before, and despite the fact that three other Big Creeks were tributaries of this same French Broad River. (See, for instance, Eastin Morris, *The Tennessee Gazetteer*, Nashville, 1834, p. 8.)

[7] It may surprise our casual traveler to be told that, precisely in the period when our sprawling village was supposed to drowse and even to slumber, several comfortable fortunes were built of its trade. Coming down to our own day, following are the figures for car-load shipments from Del Rio during the period January 1, 1942, to October 19, 1944: acid wood 570 cars; pulp wood 530 cars; logs (chiefly pulp wood) 925 cars; lumber 253 cars; tanbark 59 cars; barytes 62 cars. Average freight revenue per month $2200. (Figures furnished by Mrs. L. L. Spratt, Agent.)

Georgia, a traffic that probably reached its peak in the decade and a half following the close of the Civil War. Early in this same period (1867-1868) a railroad was built from Morristown, on the line of what was then the East Tennessee and Virginia Railroad, to Wolf Creek, a distance of forty miles. There, however, the railroad stopped dead still for a full dozen years. That pause has a special significance for the story of hog-driving; for, had the railroad forged its way at once on up the river to Asheville, the business of hog-driving, instead of flourishing for more than a decade longer, would no doubt have speedily dwindled away or come to a full stop.

The coming of the railroad had, however, for our valley another consequence of great importance. It opened a market for the timber in which the hills and mountains of the valley abounded, and straightway small water-driven sawmills went into action. (The portable steam-driven mills were introduced a little later.) But by far the most important immediate development along the waters of the creeks called Big was the shaved-shingle business.[8]

It was in 1880 and 1881 that the railroad finally wormed its way up the river to Asheville (actually the worming was mostly in the other direction), almost automatically putting an end to the hog-driving business. It chanced that at almost at that precise time the unique business of shaving shingles also came to an end. The froe, the mallet, the shaving-horse, and the drawing knife, surrendered unconditionally to the shingle mill, with its circular saw and its water or steam power.

It is, then, of these three phases of activity—the advent of the railroad, the hog-driving business, and the making of shingles—as for some twelve or fifteen years they permeated and gave tone and flavor to the community then known as Big Creek that this scribe is endeavoring to tell the story in this his book of chronicles. Moreover, this was just the period of the chronicler's early youth—from the gosling to the feathered stage—and, be it likewise known, the scribe aforesaid is the more emboldened to undertake some sort of chronicle of the doings of those stirring years because his is almost the sole surviving memory of them. It is not quite for him to say: "I only am alone left to tell the tale," for two other pilgrims have made the long journey with him—the one striding a little way in front, the other following closely in the rear—both still holding their heads high, their feet firmly planted, and both still in full command of their keen perceptions and retentive memories.[9]

If the story shall seem to be clad in garments of a somewhat heterodox character, grant, if you will, a brief explanation from the mouth of the orthodox historian. There was a time when the chronicler, then (presumably) a member in good standing and full fellowship in the congregation of orthodox historians, was possessed of a strong desire and a fixed purpose to put together such a segment of the valley's history, built almost entirely of materials drawn from a prime documentary source. This confident hope and high purpose were based on the exist-

[8] Reference omitted.

[9] These are John A. Jones, known to many as "The Bard of Del Rio," and J. W. D. Stokely, for some years a resident of Newport as a county official. Mr. Stokely, who is probably the sole survivor of the many hog-drovers of the 1870's, appears as the main witness in the story of the hog-driving business.

ence of an unbroken series of account books of the stores that, from the beginning of the period under consideration through more than half a century, stood at the gateway, taking toll of the traffic as it flowed in and out. (During most of the period there were two stores and only two.) But alas! a few years ago the building in which these books were stored went up in flames—and down in ashes. It is therefore that, of that hustling, bustling era, there is now scant record. (I pause for a moment of deep mourning and silent prayer.)

Take note also, if you will, that the chronicler arrogates to himself all the rights, liberties, privileges, and perquisites (if any) of a native son of that delectable vale, despite the fact that, technically, he is classed in the category of the "fotch on." It was all in the month of December, 1865, when he was barely one year old, plus a few insignificant days, that he was brought thither from his birthplace in Henry County, Alabama, yet it was to all intents and purposes as the return of the native. For it was to the home of his father and his father's father before him, and there is reason to believe that he was straightway gently deposited in the old wooden cradle in which his father and twelve predecessors in the family had been rocked to quietude.[10]

(As this is to be essentially a narrative of personal recollections and observations, permit me at this juncture to take refuge under the aegis of the first-personal pronoun.) First-born among my memories is one of a scene in the back yard of that ancestral home, a yard clothed in rich blue grass and shaded by great locust trees. I was not yet quite three years old, yet the picture has all the vividness of a scene at the movie last night and has faded but little if at all.

Beneath the locust trees is a long, a very long table, at one corner of which I sat in a high chair. My mother had placed me in the chair, then had turned back into the kitchen. Looking down the length of the table I beheld two rows of bearded men greedily forking (or spooning or knifing) food into capacious and rapacious mouths. I was alone with these rough-looking, ravenous men, and I was scared. If only I could find my father! Down those two long rows of busy hands and busier mouths and scarey countenances my eyes traveled from bristling beard to bristling beard, anxiously searching for my father. I found him at last, away down at the other end of the table. He was a long way off, but I was comforted. I felt safe.[11]

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[10] Elsewhere this scribe has asserted, to the bewilderment of the unitiated, that not until he was thirty-three years of age did he ever set foot on his native soil. It is at least a fair inference that at the age of one year (actually a few days less) he could scarcely have been accorded the privilege of putting his foot to the ground. That momentous ceremony had perforce to wait until the possessor of the foot could return to the scene on his own power.

[11] I venture to entrust to a footnote an incident of this out-door dining related to me early in life by an elder brother. The evening meal (supper) was usually served about sundown, but not always before the chickens that had chosen the trees of the back yard as their preferred roosting place had sought to retire for the night. Accordingly, when it came time to set the table, the chickens would be courteously but firmly admonished to go elsewhere for their nightly repose. One evening, however, a big red rooster, imbued with a spirit of freedom and with a high sense of the inalienable rights of roosters, secretly penetrated the defenses and took his accustomed perch on a limb directly over the dining table. . . .!

The meaning of this assemblage at the long dining table was no doubt a later acquisition. A railroad was being built through the valley, my father, J. M. L. Burnett, had undertaken to grade some three miles of the roadbed, through his own lands and those of his two brothers. He was feeding his crew at his own house, and, when the weather permitted, the table was set in the back yard instead of in the less spacious dining room. Other memories indeed I have pertaining to the building of the railroad, but, with one notable exception, they are less circumstantial, less easily focused by the mental camera. Perhaps they are of small moment, for I am now concerned chiefly with the manner in which the coming of the railroad impinged upon the life of the community. That other clear-cut picture, that vivid memory of an incident some months later, I shall presently offer to view.

But first let me point out briefly something of the factual background of this railroad enterprise. Actually what was occurring there was the belated fruition of an idea that had its origin amongst the earliest of railroad projects. That idea, the utilization of the French Broad passage for a railroad, had a two-fold objective: the one, to form a connecting link between the southeast and the northwest; the other, to give East Tennessee a much needed outlet to the Atlantic seaboard.

In point of time the latter purpose was first to be vigorously pressed, even though the former objective did not cease to be dangled before the eyes of East Tennesseeans, hungry for improved transportation facilities. As pointed out in the section of this narrative devoted to hog-driving in East Tennessee, the principal products of the region, live stock, had to be driven on foot to the Carolina and Georgia markets, and, for a great part of East Tennessee, the channel of the French Broad furnished almost the only practicable route for this purpose.

In the year 1831 (and notably on the 4th of July), in the East Tennessee town of Rogersville, then little more than a hamlet, appeared the first issue of a bi-weekly publication called the *Rail-Road Advocate,* whose purpose was to stimulate interest in the building of railroads for the behoof of East Tennessee. Rogersville, be it known, is only some forty or fifty miles (depending on whether we think of a bee-line or the line a crow versed in East Tennessee geography would normally fly) north of that scene of railroad activity thirty-six years later, at which the finger has just been pointed. And, be it known further, it was in this same town of Rogersville that was set up the first printing press in what is now the state of Tennessee. Further still, it was from that press, strange though it may seem, that came the earlier issues of the *Knoxville Gazette* (November 5, 1791, to October 6, 1792).[12]

Of course East Tennesseeans were not solely interested in marketing their own products—cattle, horses, mules, hogs, sheep, turkeys, ducks—they were also vitally concerned in the development of better facilities for obtaining their necessary imports. For, though they were as nearly self-supporting as any group of people in these United States have ever

[12] A file of the *Rail-Road Advocate* is in the library of the Bureau of Railway Economics, Transportation Building, Washington, D. C. Publication was discontinued June 14, 1832.

been, they did have many wants that their home economy, well developed though it was, could not satisfactorily supply. For marketing their exports their eyes were inescapably drawn to the passage through the mountains offered by the channel of the French Broad River; for obtaining their imports their eyes were just as inevitably fixed upon the Valley of Virginia and its prolongation as the Valley of East Tennessee. These imported commodities had to be laboriously and expensively hauled by wagon from Lynchburg, Richmond, Baltimore, or Philadelphia.

Although efforts toward both these objectives were pressed simultaneously, the latter—railroad connection with the East by way of the Valley of Virginia—was the earlier to be consummated, even though that consummation was long delayed. The East Tennessee and Virginia Railroad (Knoxville to Bristol), designed to connect with a line from Lynchburg to Bristol, was chartered in 1848, but was not completed until 1858. The line from Lynchburg to Bristol, the Virginia and Tennessee Railroad, was completed in 1856. The East Tennessee and Georgia Railroad (Knoxville to Dalton) was also chartered in 1848, and was completed in 1855. Between 1867 and 1869 The East Tennessee and Virginia and the East Tennessee and Georgia were combined to make the East Tennessee, Virginia, and Georgia Railroad.

Meanwhile rival projects for connecting South Carolina and Georgia with the Ohio country contended with one another, to the ultimate failure of each and every one of them to make more than brave beginnings. The French Broad route was an early favorite and remained so, although Knoxville interests in particular promoted the building of a line that would utilize the valley of the Little Tennessee, resulting in the incorporation of the Knoxville and Charleston (later named the Knoxville and Augusta). The same interests promoted the Knoxville and Kentucky, to be built from Knoxville to the Kentucky line. There was, however, but little construction on either line until after the Civil War, and neither line ever filled the measure of its destiny. Together these two projects constituted the chief competition with the proposed road by way of the French Broad, although the Hiwassee Railroad, a favorite of Georgians and the lower counties of East Tennessee, figured to some extent as a competitor.

The French Broad route was not only favored by the upper counties of East Tennessee, but also by the South Carolinians. The Charlestonians had manifested their interest in the line as early as 1827. A like preference was expressed by a convention in Asheville in 1832, by one in Charleston in 1835, and by another in Knoxville in 1836. The Knoxville convention was presided over by South Carolina's Robert Y. Hayne, who, at the close of the convention, proposed this toast: "The South and the West! We have published the bans. If any man know aught why these should not be joined together, let him speak now, or forever hold his peace."[13]

[13] For Hayne's part in the promotion of railroad development by way of the French Broad route the indispensable source is Theodore D. Jervey's *Robert Y. Hayne and his Times* (New York, 1909). Much of Book IV of that work is concerned with that phase of Hayne's career. Especially useful also is Samuel M. Derrick's *Centennial History of South Carolina Railroad* (Columbia, 1930), of which

Thus was launched, with significant fanfare and appropriate blessings, the first railroad project definitely designed to penetrate the mountain barrier by way of the channel of the French Broad River, and the name bestowed upon it was the Louisville, Cincinnati, and Charleston Railroad. Unfortunately, the Louisville, Cincinnati, and Charleston, though a lusty infant of great promise, became a victim of the financial epidemic of 1837, to say nothing of certain local infections that sapped its vitality. Through the efforts of Robert Y. Hayne, its president, it was kept alive for some two years, then, after Hayne's death in 1839, and after some perfunctory efforts to administer the railroad equivalent of blood plasma, the road passed into extinction. It was largely a story of rivalries, contentions, and conflicting interests, plus not a little of confusion thrice confounded. There are more engaging nursery stories than those which came forth from East Tennessee's railroad nursery.

Followed a decade of more or less fitful dreams and schemes of railroads for East Tennessee, then another decade of promotion and of actual building. It was during this decade, as already mentioned, that what was to become the East Tennessee, Virginia, and Georgia Railroad took on form and substance. That the French Broad project would be revived was inevitable, for it had been written by the eternal hand of geography. That revival came about in 1853, when (on November 18) the General Assembly of Tennessee incorporated the Cincinnati, Cumberland Gap, and Charleston Railroad, to run from Cumberland Gap southward through Tazewell, Bean Station, Morristown, and Newport to Paint Rock, at the North Carolina line.

The old Louisville, Cincinnati, and Charleston had definitely included Knoxville in its route, but the Cincinnati, Cumberland Gap, and Charleston proposed to by-pass that ambitious city. The charter provided that the company's activities should be confined to the upper counties of East Tennessee, nevertheless the idea that had inhered in the French Broad project from the beginning, namely, that it should form a link in a chain of roads connecting Cincinnati and Charleston, did not fail to animate the hopes and purposes of the promoters.

In fact, the by-passing of Knoxville was symptomatic of that very hope and purpose; for Knoxville lay (or stood, or sat—take your choice) to one side the natural, the geographic route of a trunkline from the southeast to the northwest. That idea was particularly stressed in the

chapters X, XI, and XII are devoted to the Louisville, Cincinnati, and Charleston project. Calhoun's advocacy of an alternative route is revealed in *Correspondence of John C. Calhoun,* J. F. Jameson, editor (American Historical Association's *Annual Report,* 1899, Vol. II, *passim.*) In John A. Cleveland's *Controversy between John C. Calhoun and Robert Y. Hayne as to the Proper Route of a Railroad from South Carolina to the West* (Spartanburg[?], 1913, p. 22) the differences between the two South Carolina statesmen respecting this question is particularly pointed up. It was this rivalry, Mr. Cleveland maintains, that "postponed for many years the completion of the line down the French Broad; and the result has been," he adds, "that Georgia has been built up at the expense of South Carolina, and Atlanta made possible, whereas the great distributing point should have been in upper South Carolina."

prospectus of the road by pointing out that the proposed railroad would follow "the very pathway—in the early history of the country—of the wild buffalo, the savage Indians of the forest and, at a later period, of civilized man, led by Daniel Boone."

In 1855 contracts were let for grading and bridging the road from Bean Station to Newport, a distance of thirty miles, and by May, 1856, a considerable part of that work had been done, including the bridge over the Holston River to the extent of one-fourth completion. Because, however, of the failure to obtain state aid, all construction north of Morristown, the partially completed bridge included, was abandoned and not thereafter resumed. It was four years later (in 1860) that the company was successful in obtaining from the state a loan of $132,000, and thereupon undertook a new spurt of construction, placing the entire road south of Morristown under contract. By virtue of these contracts some thirty miles of road were graded, considerable bridge work was done, and twelve miles of ties were laid. Then came the war, to put a stop to the whole business.

That contest at an end, a contest which for East Tennessee had much the character of a back-yard scrimmage, East Tennesseeans brushed their clothes, straightened their shirts, and resumed their agitation in behalf of railroads, both for the repair of the lines that had suffered in consequence of the war and for the construction of new lines. In May, 1866, the Cincinnati, Cumberland Gap, and Charleston petitioned the state for aid, and the campaign was on. Some three months later the chief engineer of the road, R. C. McCalla, came out with an elaborate argument for the completion of the line, emphasizing the advantages of the French Broad route over other proposed routes. He enforced his argument by means of tables of mileage by various routes from Louisville and Cincinnati to Charleston, Savannah, and other points.

McCalla's statement, dated at Morristown August 8, was spread on the first page of *Brownlow's Knoxville Whig* of September 5, 1866, occupying about three-fourths of the page. Apparently his argument bore fruit, for in December following, the Tennessee General Assembly made grants to various railroads, including $500,000 to the Cincinnati, Cumberland Gap, and Charleston. In 1867 and 1868 additional grants were made to the road, in particular one of $541,000 for iron and bridge work.

Meanwhile construction of the line had proceeded apace, even if the progress was not satisfactory to some people along the line. For instance, in the *Whig* of May 1, 1867, "A Farmer of Cocke County" complained that farmers in that locality were planting extensively with the idea that they would be able to ship out their grain by the railroad but had begun to doubt whether the directors of the road were sufficiently active in their efforts to complete the line to Pigeon River before autumn. On November 20 "Subscriber" offered an argument of considerable length in behalf of state aid to railroads. Whether or not the arguments of "Subscriber" were among the weights reckoned by the General Assembly, the state did presently make sundry grants in aid.

Came December 4, and the *Whig*, for its own part, under the headlines: "Cincinnati, Cumberland Gap, and Charleston Railroad," broke forth in this optimistic strain:

"We are pleased to announce that this important branch of Tennessee internal improvements is progressing very favorably. We learn from Major Underwood of this road, that track is laid about nineteen miles, and will be completed to Newport by Christmas, when the track laying will cease for a season. This opens up one of the richest agricultural districts in East Tennessee. Thanks to the officers and the managers of the road for the progress made."

If that promise of "Newport by Christmas" was fulfilled, no evidence of it has been found. Not until February 5, 1868, was the *Whig* enabled to report:

"The cars are now making tri-weekly trips on this road from Morristown to Newport, on Tuesdays, Thursdays, and Saturdays. Much credit is due the efficient officers of the Road for the energy with which they have pushed forward their work to the present point of termination. The road is through a rich country, and we have no doubt that it already adds materially to the prosperity of the State."

To say that the cars were running to Newport is to take liberties with geographic verities. The fact is that the railroad neither then nor thereafter came nearer to the Newport of that day, now known as "Oldtown," than a distance of two miles. Old Newport was on the French Broad River, and it was at that now almost deserted spot that Andrew Jackson spent the night of March 22, 1803. The present-day Newport, with the railroad running straight through its "goozle" and alimentary canal, is on Pigeon River and was christened Clifton, a name which it wore with some measure of pride for a good many years after the coming of the railroad. How Clifton caught old Newport in swimming and ran off with its shirt and breeches and other insignia is an intriguing story—but it's none of our present business.

It does nevertheless appear pertinent to point out that the railroad's bald profession that it had embraced Newport could not have been a case of mistaken identity. Some authorities maintain that it was a plain case of misplaced affection. At all events, the railroad has since had its uncounted seasons of repentance for having wandered from its true and proper path. For it has had to pay dearly, in steep grades and submerged track, for having forsaken the old love for the new.

How much grading had then been done beyond that terminus which the railroad elected to speak of as Newport is among the unrevealed facts. What is established is that exactly six months later an additional eleven miles of rails had been laid, two bridges had been built, one over Pigeon River, the other over Big Creek, and a train (the company sometimes said "trains," but that deceived nobody along the line) was puffing its way to within nine miles of its destined terminus, the North Carolina state line. That achievement was announced in *Brownlow's Knoxville Whig* of August 12, 1868, in this manner:

"THE CINCINNATI, CUMBERLAND GAP, AND CHARLESTON RAILROAD

"This road is now open for traffic to Big Creek, a distance of 34 miles from Morristown and 15 miles from Warm Springs, N. C.

"On and after the 10th inst., the passenger train will leave Big Creek daily (Sunday excepted) at 5:30 A. M., arriving at Morristown at 8:30 A. M.

"Returning will leave Morristown at 2:00 P. M., and arrive at 5:00 P. M.

"Will connect with East and West trains on the East Tennessee and Virginia Railroad; also on Monday, Wednesday and Friday, with one six passenger stage coach, at the terminus of the road for Warm Springs, Madison County, N. C.

"At Warm Springs, connects with mail line from Greeneville, Tenn., to Greenville, S. C., via Asheville, N. C.

R. C. McCalla, Chief Engineer.

"N. B. In about six weeks this road will be completed to Wolf Creek, a point only eight miles from Warm Springs.

"August 5th, 1868."

So there you have it, in black and white. Big Creek was for a time the terminus of the railroad, the departure and arrival of trains (or train) therefrom and thereat duly recorded in the railroad schedule. What terminal facilities were installed there I have not been able to learn.

Of one thing staring at us from the record please take note: the time of the train from Big Creek to Morristown, a distance of thirty-four miles, was three hours, approximately ten miles an hour. Bear in mind, however, that, despite Engineer McCalla's euphemistic term, "passenger train," it was essentially a freight train and normally stopped some time at every station to take on and discharge freight, to say nothing of the pauses here and there along the line to replenish the supply of wood for the engine, and even to pick up occasional passengers waiting by the track.

The day the train first came to Big Creek is for me one of imperishable memory. The date was evidently close to one side or the other of the 5th of August, 1868. Suddenly the stillness of the valley was broken by the whistle of an engine somewhere down the line, whereupon there was scurrying to and fro and hurrying hither and yon. For lots and lots of people, most of whom had never seen an engine or a train, had gathered to behold the marvellous sight. From out the school house, too, not many yards from the railroad, the children trooped, scampering and chattering excitedly. Every neck was craned and every eye was fixed toward the bridge over the creek, where the engine would first come into view . . . . There it came! . . . And one can imagine, even if he can not remember, that the horses and the cows grazing in the adjacent field went galloping in fright to the farthest reach of the pasture; and that the crows in the trees on the creek and river banks quickly choked

off their caws and scurried to safer posts of observation on the nearby hills.

There it came! . . . rattling and roaring and belching a great column of smoke from the big funnel-like smokestack. What a monster in size it was! What marvellous and mighty power! . . . Then, lo! right beside the school house it stopped, breathing noisily and squirting steam from misplaced nostrils. Dumb with amazement, everybody gaped and stared.

Directly an unbelievable thing happened. I, one of the youngest and littlest and least significant in all that throng, had bestowed upon me a privilege and a distinction granted to no one else, old or young. Even at the moment I was conscious of the glory that was mine and mine alone, and my bosom swelled with a joy of which I have never dreamed. Nor did it cease to swell, as the days went by, with a pride and exultation surpassing anything that later life has brought me. In the full stare of that crowd of men, women, and children, my father lifted me up into the cab of the engine, himself took the fireman's seat, with me in his lap; whereupon the engine began to puff! puff! puff! and up the road we went, on the most wonderful ride of my life.

I suppose we rode as far as the rails had then been laid—it was as far as Uncle Jefferson's house, which had barely been missed by the railroad, about a mile distant—then we came back. Throughout my youth I carried a definite impression that the engine had turned around. When, however, a man grown, I sought to learn where the turntable had been located, I was informed that there never had been a turntable nearer than Wolf Creek.

That engine, Brethren and Sisters, I would have you to know was "Old Buncombe," of fame and fable—much fame and a little fable. Just when and by whom it was first called "Old Buncombe" I know not; but I do know why. It was headed for Buncombe County, North Carolina, and, God willing, it hoped some day to get there. Anyway, "Old Buncombe" it became in every mouth from Morristown to Wolf Creek and the regions roundabout, and doubtless also all along the windings of the French Broad, where people watched and waited for its coming, even amongst the dwellers of the county that proudly posed as the godfather. Even the road itself came in time, in common parlance, to be dubbed "Old Buncombe," although the unregenerate, the unromantic, might call it coldly the Buncombe road.

Throughout the life of the Cincinnati, Cumberland Gap, and Charleston Railroad we never, I think, saw any other locomotive but good "Old Buncombe," and it became entwined and deeply imbedded in our affections. The story of "Old Buncombe," if rightly told, would be a romantic tale. It would comfort me deeply if I knew that the hero of the tale had a place of honor in the Valhalla of locomotives of the rails. I would go far to do "Old Buncombe" reverence. To mount again, as I did at the age of three, to the throne of that monarch, the engineer, to feel once more that exultant thrill that has bubbled fresh in my memory even to these remote years, would fill my soul with a joy that passeth understanding.

Engineer McCalla's promise of "Wolf Creek in six weeks" was actually drawn out to a full four months. It was not until December 9, 1868, that the *Whig* carried the announcement that the road had been completed to Wolf Creek. That announcement, under the caption, "Cincinnati, Cumberland Gap, and Charleston Railroad," is as follows:

"TRAINS NOW RUN TO WOLF CREEK,

40 miles from Morristown, and 8 miles from Warm Springs, North Carolina. Connect at Mossy Creek with Stage Line for Asheville and Morganton, N. C., and Greenville, S. C. This is the shortest, cheapest and best Route from East Tennessee to the interior of the Carolinas.

"Trains will run tri-weekly on Mondays, Wednesdays and Fridays, as follows, making close connections with East Tennessee and Virginia Road, and Stage Line at terminus of Road.

"Leave Mossy Creek 6:30 A. M. Arrive at Morristown 9:50 A. M.

Returning:

"Leave Morristown 1:45 P. M. Arrive at Wolf Creek 5:05 P. M.

R. C. McCalla, Superintendent.

"Morristown, Tenn., Dec. 5."

The appearance of "Mossy Creek" twice in this advertisement, where evidently *Wolf Creek* was intended, is something that doubtless not even Parson Brownlow's printer's devil was ever able to explain. What is particularly strange is, that the advertisement was carried in the paper for more than seven months with that error staring at the reader like protruding eyeballs. On June 9, 1869, the advertisement was altered to read:

"Trains will run Daily, making close connections," etc.;

but "Mossy Creek" did not budge. Not until July 14 was that error corrected.

The advertisement was signed, "W. J. Taylor, Superintendent." This was the "Captain" Taylor who presently became conductor on the line and as such was the road's alter ego for a quarter of a century. A man of kindly spirit, he was highly regarded by everybody along the line, and knew every man, woman, and child who customarily traveled on his train. Unquestionably he held my father in high esteem and deep affection and, when I took over the office of station agent, he gave to me ("Eddie," he always called me) a fatherly interest and concern. For my part, the memory of him is one of the treasures of my youth.

It was nearly at the same time (July 7) that a companion advertisement appeared in the *Whig*. This was to announce the inauguration by J. C. Hankins and Co. of stage services from Wolf Creek. With typographical display not here imitated, Messrs. Hankins say:

"We are running a four horse coach from Wolf Creek, Tennessee, to Morganton, via Asheville, N. C., and return tri-weekly. Our coaches are new, and our stock good. We are running a daily coach from Wolf Creek to Warm Springs."

Follow some remarks in praise of that "far-famed watering place," its "grand scenery, its pure mountain air, and its Sulphur and Chalybeate Springs—warm and cold."

Then and there it was—at Wolf Creek in the beginning of December, 1868—that the Cincinnati, Cumberland Gap, and Charleston Railroad halted in its progress and never thereafter, under its own banner, ventured to approach nearer to the destination prescribed in its charter, the dividing line between Tennessee and North Carolina. Mr. R. O. Biggs, who once probed into the history of that enterprise, was never able to find a satisfactory explanation of the failure to build the remaining three or four miles at that time. Whatever other reasons there may have been, one only was sufficient.

The Cincinnati, Cumberland Gap, and Charleston had been built with the full expectation that it would be met at Paint Rock by a line coming down the river from Asheville. By the time construction on the Tennessee side had reached Wolf Creek it had become evident that that appointment would not be kept, not at least for some time to come. The North Carolina part of the projected link had become hopelessly mired in political and financial muck, so that the hand-shaking across the line, or whatever happy ceremonies of union may have been planned, had perforce to wait.

As for the C. C. G and C. R. R., why should it thrust its nose into that constricting crack in the mountains known as Paint Rock? Why not wait comfortably at Wolf Creek, where it could at least get its breath? The wait was long, twelve years, in fact. Meanwhile the Cincinnati, Cumberland Gap, and Charleston Railroad had soon found itself in sore financial difficulties. The result was that in 1871 (October 10) that road was gobbled up by the East Tennessee, Virginia, and Georgia, and it was as a branch of that road that in 1881 the meeting at the state line, long ago planned, was finally consummated.[14]

[14] Aside from the excerpts from *Brownlow's Knoxville Whig*, liberally spread over the preceding pages, the principal basis of this sketch of the Cincinnati, Cumberland Gap, and Charleston Railroad has been "The Development of Railroad Transportation in East Tennessee during the Reconstruction Period," an unpublished University of Tennesse Master's Thesis (1934), by Riley Oakey Biggs. The Library of the University of Tennessee generously lent me the manuscript of the thesis for use in preparing this sketch.

An over-all picture of the agitation for and the development of railroads in East Tennessee, particularly prior to and immediately following the Civil War, may be drawn from a series of papers in the *East Tennessee Historical Society's Publications*, namely: James W. Holland, "The East Tennessee and Georgia Railroad, 1836-1860" (No. 3, 1931); James W. Holland, "The Building of the East Tennessee and Virginia Railroad" (No. 4, 1932); S. J. Folmsbee, "The Beginnings of the Railroad Movement in East Tennessee" (No. 5, 1933); S. J. Folmsbee, "The Origins of the Nashville and Chattanooga Railroad" (No. 6, 1934); R. O. Biggs, "The Cincinnati Southern Railway: A Municipal Enterprise" (No. 7, 1935); and Thomas D. Clark, "The Building of the Memphis and Charleston Railroad" (No. 8, 1936). Other studies in the same or related fields are: Thomas D. Clark, "Development of the Nashville and Chattanooga Railroad," in *Tennessee Historical Magazine*, ser. 2, vol. III (April, 1935); R. S. Cotterill, "The Beginnings of Railroads in the Southwest," in *Mississippi Valley Historical Review*, March, 1922; id., "Southern Railroads and Western Trade, 1840-1850)," *ibid.*, March 1917; *id.*, "Southern Railroads, 1850-

Such was the brief, the ambitious, the thwarted career of the Cincinnati, Cumberland Gap, and Charleston Railroad, which, despite its name, knew Cincinnati only in the dreams of its promoters, never came anigh Cumberland Gap, and succumbed to its untimely fate while yet Charleston was in the far, dim distance. By the time that forty-mile link had been welded into the long chain the very name it had borne had been all but forgotten. The chain dreamed of by Robert Y. Hayne, and innumerable lesser men has, in fact, never been completely forged. Some years ago there was a rebirth of the idea, with the result that the building of the line between Morristown and Cumberland Gap was once more undertaken; but it proved abortive, if not downright fraudulent. If that episode did not make the great South Carolinian turn over in his grave, nothing could disturb his slumber.

In this sketch of the Cincinnati, Cumberland Gap, and Charleston Railroad I have left to one side the participation in the enterprise by the people of the region served by the road. That phase of the undertaking, particularly for that era of construction prior to the Civil War, has been dealt with somewhat at large by Mrs. Ruth W. O'Dell, in a chapter of her forthcoming history of Cocke County. For instance, she gives a list of some forty-odd stockholders in Cocke County, who held from two to twenty-five shares each. Other phases also of the coming of the railroad are related by Mrs. O'Dell in a manner both interesting and enlightening, with attention directed for the most part to Newport and its environs. The present scribe, on the other hand, is endeavoring to draw attention to another area, also for a short time the terminus of the railroad, and to the impingement of its coming upon life and the pursuit of happiness thereabouts.

The aids and comforts vouchsafed to the railroad by the people of Big Creek (and *vice versa*) were no doubt typical of the ways and means employed generally for the consummation of the enterprise. Citizens of Big Creek were, for instance, among the early subscribers to stock in the road. In the matter of rights of way also Big Creek probably offers typical examples. Some rights of way were donated, some were purchased outright, some were acquired by condemnation. My father, for instance, donated the right of way through his hands (a matter of only five or six hundred yards), whereas, in the case of the

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1860," *ibid.*, March, 1824; St. George L. Sioussat, "Memphis as a Gateway to the West: A Study in the Beginnings of Railway Transportation in the Old Southwest," in *Tennessee Historical Magazine*, March, June, 1917; U. B. Phillips, *History of Transportation in the Eastern Cotton Belt* (New York, 1908); Theodore D. Jervey, *Robert Y. Haynes and his Times* (New York, 1909). The Western North Carolina phase is dealt with by Cecil K. Brown in "A State Movement in Railroad Development," in *University of North Carolina Social Studies*, 1928. All these studies abound in citations of primary sources. Covering a much wider scope but including developments in East Tennessee is Fairfax Harrison, *A History of the Legal Development of the Railroad System of the Southern Railway Company* (Washington, 1901). The geographic factors in the transportation problem of East Tennessee are well set forth by Professor Stanley J. Folmsbee in chapter I of his book, *Sectionalism and Internal Improvements in Tennessee, 1796-1845* (Knoxville, East Tennessee Historical Society, 1939) Chapter IV relates the movement for a railroad by way of the French Broad.

adjoining lands of his two brothers, a distance of some three miles, the process was condemnation. Curiously enough, the case remained in litigation for more than a quarter of a century and was finally adjudicated after one of my uncles had been dead a good many years. I was once given to understand that the railroad company deliberately kept the case in court as cheaper than paying interest on the sum involved.

Comparatively recent years have witnessed, all up and down East Tennessee, a chapter of lawsuits over rights of way, involving what the courts have termed the right of adverse possession. In consequence many a landholder, who through the years had sat serenely atop his own dunghill, as he supposed, found himself rudely deposited over the barn-lot fence, there to reflect upon the aid, the comfort, the joyous welcome which one or another of his forebears had accorded to the railroad at its coming.

A somewhat similar development had long before taken place in another domain of the *quid-pro-quos* so extensively utilized by the railroads in their early struggles for existence. One of the quids handed out by the railroad promoters, perhaps all too generously, in partial return for rights and privileges, was a right of free passage over the line, including oftentimes the whole family, as well as the head thereof. The Cincinnati, Cumberland Gap, and Charleston Railroad accorded to my father and his entire family the right of free travel over the road, and not until the early '80's, some ten years after the East Tennessee, Virginia, and Georgia had taken over did any of the family ever pay fare between Morristown and Wolf Creek. Suddenly that right for the family was withdrawn, although my father was privileged to ride free as long as he lived. It is my understanding that the Southern Railway, successor to the E. T. V. and G. inherited a multitude of "perpetual" passes, but prevailed upon the courts to annul them, one and all.

In another particular our community offers a striking illustration of a means employed in early railroad building, how extensively I am unable to say, whereby the railroad might be enabled to go farther and fare better. The depot at the station called Big Creek was not built by the railroad company, but by a stock company composed of citizens of the community. My father furnished the land and took a majority of the shares (eventually he acquired them all), and the depot was then leased to the railroad. What the rental was in the beginning I do not know, but in the early '80's it was fifty dollars a year, paid in monthly installments of $4.15.

In the case of still another *quid* I have reason to conclude that there was nothing in the nature of a *quo* involved. Straightway upon the arrival of the railroad at Big Creek my father was made station agent, and he retained that office until his death (August 1, 1883). It was not a lucrative office by any means. In my day it paid the munificent stipend of $20.85 a month. Although during most of that period the duties of the office were performed by a deputy (one or another of the "storekeepers"), in the earlier years my father evidently gave the office more or less of personal attention.

One of my distinct recollections is of the evenings at home when, with my mother's aid, he made out the monthly reports. One of the oft recurring phrases read out by my mother sorely puzzled me: "Way-Bill 17 . . . Way-Bill 21 . . . Way-Bill 36," and so on. I wondered which one of the several Bills I knew was getting something or other weighed out to him. Meat, very likely. That's what most of them got. (Not so many years ago there were still some of those old Cincinnati, Cumberland Gap, and Charleston way-bill blanks stuffed back in a closet of our house.)

In the beginning of January, 1883, my father withdrew me from college, in the conviction that my health was giving way (a conviction that soon proved to be well founded) and set me to work in the depot as his deputy. When he died, August 1 following, I was appointed station agent in my own name, and held the office for some three years. It was not, as I have said, a lucrative office, even in those days, when a dollar would fetch a lot more than it will today; neither was it a position of large authority in the operation of the road, still there was plenty of work to do, and plenty of fun. Most of all, it was an advantageous post from which to view the passing scene. And what scenes there were! Of them I might many a tale unfold—tragedies, near-tragedies, and comedies galore. But they can wait or else pine away, mayhap. One consequence of that experience nevertheless I venture here and now to reveal. Though my career as a railroader was comparatively short, and though some three score years have elapsed since its termination, in my veins still runs some of the juice which some poetically minded scribbler has called "the spirit of the rails"!

It was near the close of my career of railroading that occurred one of the significant turning-points in the history of railroads in the United States, one that I deem worth recording briefly here. This was the adoption of a uniform gauge. It was something with which I as station agent had nothing whatever to do, yet it does serve to mark my administration(!) as snuggling in a notable era of railroading. That stern potentate of the East Tennessee, Virginia, and Georgia, Division Superintendent Major F. K. Huger, would seem to have regarded it entirely unnecessary to notify me officially of the coming event, and I was accordingly left to discover it through a multitude of posters tacked up on depots, telegraph poles, and trees all along the line, calling for thousands of men for certain days to assist in carrying out the programme of change of gauge.

That there were many different railroad gauges over the country I already knew, as I knew also something of the handicaps to passenger travel and the movement of freight caused by these variations of gauges. For that reason, if for no other, at many junction points passengers had to change cars, and freight had to be transferred from one car to another. The latter in particular was enormously costly. Though some progress had been made toward a uniformity of gauge prior to 1871, in that year there no fewer than nineteen different gauges in the United States, varying from three feet to six feet. In 1869 the Pennsylvania Railroad had adopted a gauge of four feet, eight and one half inches for its passenger

tracks and four feet, nine inches for its freight tracks; and the trend in the north had been toward one or the other of these gauges.

Southern roads, on the other hand, had for the most part been built with a five-foot gauge, following the example of the S. C. Canal and Rail Road, pioneer among railroads, but that gauge was not quite universal in the South. Moreover, there were technical arguments in favor of the five-foot gauge, and the story that that gauge had been adopted in the South for obstructionist purposes seems to be apochryphal. Be this as it may, when the programme for uniformity throughout the whole of the United States was pushed to a consummation, it was the South that surrendered.

The change of gauge in the South was put through, with minor exceptions, in two days, May 31 and June 1, 1886, and is counted one of the marvels of efficiency. For some reason or other our line, the North Carolina division of the East Tennessee, Virginia, and Georgia Railroad, was made one of the exceptions. That change was made on Wednesday, May 26, and it was done by moving the north rail three inches inward. There were of course no trains run over the road that day.[15]

I began this story of the Cincinnati, Cumberland Gap, and Charleston Railroad on a personal note; and I should like to end it on a like note, even if in a somewhat different key. The passages respecting "Old Buncombe" have been left essentially as I wrote them five years ago. Thereafter I set about, somewhat perfunctorily at first, but with increasing zeal, a search to learn what had become of "Old Buncombe," if indeed that old dame had survived the ravages of time and, if so, where might she now be reposing. If I were not a very matter of fact person, I might compare my search to the quest for the Holy Grail.

Mr. R. L. Eddington, Assistant Secretary of the Southern Railway, successor of the E. T. V. and G. and therefore heir and assign of the C. C. G. and C., was unable to offer any clue. I then betook me to the Library of the Bureau of Railway Economics, with a like result, except for the counsel that I prod the Railway and Locomotive Historical Society of Boston, Massachusetts. From the president of that society, Mr. Charles E. Fisher, I received a letter, dated May 30, 1945, which, while not quite solving the problem, deserves, nevertheless a place in this record.

After speaking of the transfer of the Cincinnati, Cumberland Gap, and Charleston to the East Tennessee, Virginia, and Georgia, Mr. Fisher

[15] The instructions issued by Superintendent F. K. Huger for the change of gauge on the East Tennessee Division and branches is recorded at length in the *Railroad Gazette* of June 4, 1886, p. 377. A history of the standard gauge in the United States is an editorial contribution to the *Railway Gazette* of July 11, 1941. (The *Railroad Gazette* and the *Railway Gazette* are not one and the same.) The Knoxville *Daily Chronicle* of June 1 1886 (page 5) gives half a column to the change then in progress and carries a despatch from Lynchburg, dated May 31, to the effect that the Norfolk and Western would make the change on its entire system June 1. Incidentally, on May 25, the day before the programme was inaugurated on the North Carolina division, the East Tennessee, Virginia, and Georgia system was sold under the hammer in Knoxville for ten million dollars. A short account of the change of gauge over the United States is also found in Carl R. Fish, "The Northern Railroads, April, 1861" (*American Historical Review*, July, 1917).

remarks: "The road at the time of its purchase by the E. T. Va. and Ga., owned one locomotive, 1 baggage and 3 platform freight cars." Then he goes on to say:

"Names were removed from the locomotives on the E. T. and Va. R. R. in 1868, thus no names appear listed on the E. T. Va. and Ga. rosters of 1871 and 1872 that we have here. The latter report is dated July 1, 1872. This report shows that ETV and Ga. locomotive No. 32 was originally purchased from the Rogersville and Jefferson R. R., taken over by the ETV and Ga. R. R. in 1872, that it had been thoroughly overhauled at a cost of $4000, and was now running on the CCG and CRR. I don't know how many locomotives the R. and J. had, the road was in the process of reconstruction at the time the ETV and Ga. took it over. It is safe to assume that they had at least one and this would seem to fit the case, as ETV and Ga. locomotives 34 and 35 appear on the 1872 roster for the first time. Now it would seem as tho' the road swapped these two engines after the roads were acquired, for the 15 mile R and J got your friend "Old Buncombe" and the CCG and C got the one that was formerly the property of the R and J. Both locomotives were alike, 13x24 inch cylinders, 60 inch drivers and weighed 24 tons. The builder of "Old Buncombe" appears to have been Norris and Sons of Philadelphia, while the builder of the locomotive on the CCG and C after July 1, 1872, was Anderson and Delany of Richmond, Virginia. The dates of construction, unfortunately are not given, but the smallness of these locomotives would make them to be quite old. Although the southern railroads used small engines up to and after the Civil War, these engines were probably built in the 1850's. Anderson and Delany, as partners, built locomotives from 1855 to 1858; Norris quit building locomotives in 1866 but was turning out much larger engines."

If Mr. Fisher's inferences from the cited records are correct, then the engine we knew from 1872 on was not the "Old Buncombe" that came tearing up the road in the summer of 1868, belching fire and smoke. How mortifying! Were there, after all, two "Old Buncombes"? My mind is open to conviction, though my soul refuses to accept that verdict.

Next it was my good fortune to learn that Mrs. Ruth W. O'Dell, the historian of Cocke County, Tennessee, had likewise been trailing "Old Buncombe" and had made some notable discoveries. For one thing, she had dug up an "old newspaper clipping," unidentified except by the designation "old," which has this to say:

"Old Buncombe was an eight-wheel locomotive, built by the Rhode Island Locomotive Works for the Cincinnati, Cumberland Gap, and Charleston Rail Road Company. It was the only locomotive owned by this road. She made a round trip of eighty miles every day except Sundays, and for seven years without being in an accident." Then the clipping quotes from the pilot who pulled "Old Buncombe's" throttle for many years:

"The old engineer, Decatur Craig, said of her: 'She presented a fine appearance, with brass shining like mirrors and iron and steel parts

rubbed bright as nickel plate, the driving wheels painted a bright red, and the cab and pilot a dark green. She weighed about thirty tons, carried one hundred and fifty pounds of steam and had cylinders fifteen by twenty inches. The boiler was of the wagon-top variety.' "

It will be observed that there are some discrepancies between the description here given and that furnished by Mr. Fisher of E. T. V. and G. engine No. 32, acquired from the Rogersville and Jefferson Railroad. It is scarcely to be doubted that one who lived so intimately with an engine and for so many years as did engineer Craig knew his "Buncombe" from top to bottom, inside and out. But was *his* "Old Buncombe" the "Old Buncombe" of 1868? The query refuses to down. As to the real name of Old Buncombe the First—if there was a second—Mrs. O'Dell has discovered that it was GOVERNOR SENTER, named for the Governor of the state. My own uncertain memory seems to accord with this.

Finally, strange to tell, shocking to hear, hard to believe, Mrs. O'Dell's trail of "Old Buncombe" led her into the wild woods of Sevier County, Tennessee, to a locality known as Spruce Flats, where that once proud monarch of forty miles of rails now stands idle and "slowly rusting away, unwept, unhonored, and unsung." From joyously, exultantly, pulling freight and passengers, she had descended to the humdrum business of powering a saw mill. How are the mighty fallen! Still and all, it is comforting to be told that she zealously adapted herself to her new occupation and faithfully "done her derndest." She could lay out as much as fourteen thousand feet of lumber daily.

Well, lack-a-day! lack-a-day! If this in truth be "Old Buncombe," *my* "Old Buncombe," it is to weep, it is to wail, it is to gnash the teeth. But no. This can not be the real "Old Buncombe." These bones of steel and iron are but the forsaken remains. *"Old Buncombe" had a soul!* . . . Come, let's leave this gruesome cemetery. Let's get back to the old Cincinnati, Cumberland Gap, and Charleston Railroad, where our imaginations may have scope to loiter or to soar, where we may once again, if only in memory, listen to "Old Buncombe" come roaring around the bend and behold her plunging to a full stop in all her pristine glory.

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EDITOR'S NOTE:—Since reading the above contribution, your Editor has made another search through his records, this time with better success and to vindicate the statement of her old time engineer—Decatur Craig. "Old Buncombe" came out of the Rhode Island Locomotive Works on July 12, 1867 as the "Gov. Senter," construction No. 17, with 16x22 inch cylinders, 60 inch drivers and weighed probably, thirty tons.

# "The Future of the Steam Locomotive As Viewed From a Historical Background"

*Address Given Before The Railway & Locomotive Historical Society New York Section—January 19th, 1945.*

By Fred P. Huston

The future holds great promise for the steam locomotive, a conclusion not only deducted from a study of its historical background, but one logically arrived at by comparing it with its present day competitors and by a glance into the future.

Its background extends back into the dim, obscure past to the very beginning of land transportation—back before the age of man—say to the day Mama Pithecanthropus erectus cradled Baby Pithecanthropus erectus in her arms, or slung him over her back with a grunt that meant "stay there or I'll bite your head off," and transported him to a place of safety out of reach of the sabre toothed tiger. That was about the year 1,000,000 B. C. in the Cainozoic age.

I have chosen the Cainozoic Age as the fundamental background, nebulous though it may be, because that is the age referred to as the age of the Growing Brain. Brain growth proceeded at an infinitesimally slow rate for nearly a million years. Seemingly no progress was made in the field of land transportation until about the year 50,000 B. C. when the records show that Homo Sapiens entered the scene with domesticated animals. By comparison, Homo Sapiens made rapid progress though it was not until 40,000 or so years had passed before the genesis of the steam locomotive appeared on the background—the wheeled vehicle.

The background begins to shape up, not only for the steam locomotive, but for all technological developments about the year 2500 B. C., 4500 years ago when standards of length, weight, capacity and time were fixed by royal edict by the rulers of Babylonia. These standards in conjunction with multiplication tables, squares, cubes, geometry and rudimentary formulae which came into use at that time is the background of the implements we use for design.

Another 2500 years passed, then a bright object appeared on the background, the steam turbine conceived and built by Hero of Alexandria sometime between the first Century B. C. and the third Century A. D.

Time marched on for nearly 2000 years, which brings us to the time a couple of months ago when the turbine driven locomotive No. 6200 made its appearance on the Pennsylvania Railroad. But, more of that later.

In the interim between Hero's toy turbine and the Westinghouse turbine that powers locomotive 6200, a toy itself in size and weight but a giant in its capacity for delivering power, the reciprocating steam engine came into being. A most unfortunate circumstance in a way. But we must be fair and accord to Thomas Newcomen all honor and glory for his contribution in building the first practical steam engine. This was in 1712 or about 1700 years after Hero.

Although the principle of the steam turbine was fairly well known the progress made in the reciprocating steam engines overshadowed turbines in those early days and greatly retarded their development.

Steam locomotion followed Newcomen's stationary engine in about 75 years with Oliver Evan's amphibian wheeled scow in America, William Murdock's model locomotive, and others, but it was not until nearly a hundred years after the Newcomen engine that steam driven traction engines were used on rails. Robert Trevithick is accorded first honors for his engine built in 1804. Tracks had been in use about 200 years and the engine 100 years when Trevithick applied the principle in use today of a reciprocating steam engine driven locomotive pulling its load by virtue of the adhesion of the rim of a driving wheel on a smooth rail.

In the quarter century starting with Trevithick in 1804 and ending with Stephenson's Rocket in 1829 a number of locomotives were built by a dozen or so builders. Stephenson's Rocket was epochal, being the first to combine in the one locomotive the essential features found in our present day locomotives—staybolted water jacketed firebox—fire tubes—induced draft by means of the exhaust steam nozzle and stack arrangement and pistons connected directly to the driving wheels. The Rocket was Stephenson's 18th locomotive. Its design included the best features, not only of his own large experience, but also of the other designers in that active period of locomotive building in the early 1800s.

As Stephenson's Rocket is epochal so I accord the same standing to P. R. R. locomotive No. 6200, though locomotive No. 6202 on the London, Midland and Scottish Railway is a mighty close second. L. M. & S. No. 6202 is a direct connected steam turbine driven 4-6-2 express locomotive of 2000 hp. built in 1935, operating non-condensing on 250 psi. steam at 750°F. supplied by a conventional boiler. The turbine and drive arrangement of the two locomotives are quite similar.

As with the Rocket, these are not the first of their kind. The first direct connected steam turbine drive locomotive of which I have a record was built about 1920 in Italy. A small locomotive with an 0-4-0 wheel arrangement driven by four turbines, two on each side operating non-condensing. Others followed shortly after—including the Winterthur, Sweden, Maffei—Germany—Beyer, Peacock—England—Ramsey—England and others. These later were operated condensing with various types of condensers including combined air and water cooling.

So it seems that had more attention been given the steam turbine in the 115 years between Newcomen's stationary engine and Stephenson's Rocket, a turbine drive might have been available to Stephenson and we would not be forced into the need of displacing the reciprocating steam engine from its last remaining footing. But let us look again at the dates:

About 100 A. D. Hero's steam jet turbine.

About 1500 years to 1629—Branca inverted the impulse type steam turbine.

51 years to 1680—Bishop Wilkins gas turbine.

52 years to 1712—Newcomen's reciprocating steam engine.

72 years to 1784—Wolfgang de Kempler and James Watt both obtained patents on steam turbines.

55 years to 1829—Stephenson's Rocket.

14 years to 1843—Pilbrow obtained a patent on a steam turbine.

40 years to 1883—DeLaval made the first practical application of a steam turbine for driving his cream separator.

1 year to 1884—Parsons built his first turbine which developed ten horsepower at 18,000 R. P. M.

60 years to 1944--114 years after Stephenson, P. R. R. Locomotive No. 6200—the first direct connected steam turbine driven locomotive on this Continent.

Within the period of the past half Century the steam turbine has made such rapid strides—that's the wrong word—"strides" imply reciprocating motion—I should say has advanced so rapidly that it has almost entirely displaced the reciprocating steam engine as a prime mover with the sole exception of the steam locomotive.

So much for the historical background.

The performance records set by the newer steam locomotives should leave no doubts as to the extent of the improvements that have been made within the past quarter century. The changes bringing these improvements have been gradual—evolutionary rather than revolutionary and unless some new discovery is made that we cannot foresee, the changes toward greater improvements will continue to be gradual—will continue to be evolutionary.

The improvements in performance have not extended in like degree except in a few instances to reduce the cost of maintenance and repair, particularly in the boiler. I should like to discuss briefly the various items that require boiler maintenance—such as leaky staybolts, cracked side sheets, split tubes and cracked rear tube sheet ligaments, cinder cutting and plugging of tubes and flues, the cracking of the boiler shell at rivet joints and at other locations where cracking is experienced. I propose also to compare the present day steam locomotive with its competitors, the electric and the Diesel electric and say a few words on the gas turbine locomotive that is on its way.

Then I should like to indulge in some predictions concerning the coal burning steam locomotive of the near future with the object of dispelling the fears of those who may feel that the steam locomotive will be unable to hold its own.

Through the process of gradual and cautious change the steam locomotive of 1970 will be radically different from the steam locomotive of 1945.

Main line electrification can be expected to expand within the next quarter century to a degree where perhaps 20 percent of the freight and passenger traffic will be handled with electric locomotives and motor cars, 70 per cent with steam and the remaining 10 percent with Diesel-electric and gas turbine locomotives.

### Electric Locomotives

The electric locomotive is ideal in several important respects. The efficient utilization of weight on the drivers and high starting torque smoothly and uniformly applied enables it to start and rapidly accelerate heavy trailing loads. The amount of horsepower, limited only by the temperature rise in the motor windings and the line voltage drop, makes it a more powerful locomotive pound for pound than the steam, Diesel-electric or gas turbine locomotive.

Research in plastics has given us recently a winding insulation which sets a new limit on motor output—that of the softening of the soldered connections and the annealing of the commutator bars rather than the present limit of temperature at which the motor begins to fry and emit clouds of acrid smoke.

Soft solder will make way for silver solder and a copper which will not soften at the present limiting temperatures can be made available for commutator bars hence the advance will be made to a greater output for a given weight or an equal output with less weight.

The electric locomotive is quiet, except for the rumble of the wheels and free from smoke, dirt and the fumes of engine exhaust. These are of no small importance in the interest of public health in thickly populated urban and suburban areas.

Post-war planning could well include a more extensive use of electric power by tying together our vast net works of transmission lines, adding coal burning and hydro electric generating plants to supply power at economical rates for the use of all railroads serving each large center of population. Later the gas turbine may contribute a share by utilizing the energy wasted in hot gases by steel mills and the like. It is out of the question for each individual railroad throughout the country to electrify independently due to the high investment and operating costs of power stations, transmission, and the distribution lines for relatively small demands.

J. V. B. Duer, Assistant to Vice-President, operation of the Pennsylvania Railroad in a paper read before the New York Railroad Club, March 16, 1944 gives encouragement to the steam minded in saying—"... in pointing out the advantages of electrification, I am thoroughly mindful of the fact that the steam locomotive, as far as the Pennsylvania is concerned, is an excellent means of moving trains. It is not obsolete by any means, nor is there any possibility in my opinion, of its becoming obsolete."

And in comparing the electric locomotive with the steam locomotive, Mr. Duer said, in speaking of the benefits of electric operation "... it is not unusual on the Pennsylvania to get 70,000 gross ton miles per freight train hour as compared with 60,000 with a steam locomotive in equivalent service." This is a compliment to the steam locomotive, a difference of only 14 per cent in its ability to produce useful work at an investment of probably as little as one quarter the overall first cost including everything.

## The Diesel-Electric Road Locomotive

Do we have Diesel-electric road locomotives because they are so good or because steam locomotives are so bad? Do we have Diesel-electric because enterprising Diesel engine builders and electrical equipment manufacturers combined their products, assembled them on a chassis to offer the railroads a type of motive power having attractive advantages over steam?

The first road Diesel is in its eleventh year of service. Today the number has increased to nearly 900. While it is difficult to analyze the present day trend in road locomotives due to the disruption of war in normal balance it seems safe to assume that if the Diesel engine and the electrical equipment builders were able to fill the orders Diesel-electrics would over-shadow steam for new constructions.

The popularity of the Diesel-electric is the healthiest thing that could have happened to the steam locomotive. Now we can see the wisdom of the words of J. W. King in his excellent paper "The Unwritten Laws of Engineering."

"In a competitive world you *must* take chances—bold and courageous chances—or else the other fellow will and he will win out just often enough to keep you running all out of breath, trying to catch up."

That seems to be the position those that see a future for the steam locomotive are in. A lot of running is being done trying to catch up with the Diesel and progress is being made.

The Diesel lends itself to intensive utilization which accounts for its ability to reach high individual mileages of 390,000 per year in passenger service.

However, new steam locomotives have run up amazing records of 250,000 miles a year. Comparing the two records on the basis of dollars invested it means that roughly one locomotive mile per dollar for the Diesel and two locomotive miles for the steam.

A Diesel-electric *must* turn over a high yearly mileage to offset its high first cost. The more a locomotive costs the more it must be used.

The future of the Diesel-electric locomotive depends entirely upon a constant supply of a petroleum distillate at a favorable price.

The fuel cost per drawbar horsepower is about the same for the Diesel-electric as for the steam. On a B. T. U. basis Diesel oil costs from 2.5 to 3 times that of coal. The ratio of thermodynamic efficiency in favor of the Diesel is about 3.1 to 1. This leaves little room for increase in the price of oil before the Diesel is placed at a disadvantage.

J. E. Davenport, V. P. Engineering, Development, and Research, American Locomotive Co. made thought-provoking statements in his address before the Western Railway Club in Chicago on April 17th last year; after giving an optimistic discussion of the road Diesel's future based on performance and operating characteristics in general, he said—

"Fuel is an important item in Diesel operating costs and it is entirely possible that the post-war years might see a rise in Diesel fuel prices to a point where it would markedly affect the economy of Diesel operation . . . .

"It is also conceivable that considerations of national security and long range economic planning may lead to a program of fuel conservation in which the uses to which coal, oil and other fuels may be put will be prescribed by Government policy."

To continue the quotation from Mr. Davenport's address:

"About the only certainty in this entire uncertain fuel picture is the fact that we have enough coal to last for two or three thousand years."

Herein lies the great incentive to continue to improve the coal burning steam locomotive.

## The Gas Turbine Locomotive

What is the use of spending time and money on improving the steam locomotive with the gas turbine on the way? So I have been asked.

A Junior Engineer of one of our large companies, fired with healthy enthusiasm, had his gas turbine locomotive planned out except for one troubling detail—it lacked weight necessary to hold the drivers to the rail. His mind was relieved when pig iron was suggested as cheap ballast.

Behind the development of the gas turbine is a great deal of talent, seasoned and experienced engineers and scientists, young engineers full of boundless enthusiasm and fresh ideas like the one mentioned—metallurgists striving to find the right combination of metals to make an alloy to withstand the new condition of high stress at high temperatures over long periods of time. Our own metallurgists at Huntington are definitely included, and last but by no means least—Governments of the United States and Canada.

Several knotty problems remain to be solved before the gas turbine locomotive is ready for general use as road and switch engines. There is little doubt that the engineering and metallurgical problems will be solved. When it is difficult to say. We can wish that only a tenth of the energy now directed to developing the gas turbine could be directed to the problems of the coal burning steam locomotive.

Dependent as it is on petroleum fuel, the gas turbine locomotive should not hinder the development of the steam locomotive. It can be expected to compete with the Diesel-electric mainly for road service rather than with steam.

Regardless of the critical treatment given the competitors of the steam locomotive it must be realized that there is a place in our vast railway system for each and every type of motive power. The coal burning steam locomotive has stood the test of time, in spite of its faults. As far back as the 1880s a writer, in describing the cars of a miniature electric railway, declared "it really looks as if the hour of doom has struck for steam."

In my school days, about 35 years ago, the electric locomotive would surely displace the steam locomotive. That has proved to be as wrong as the prediction current at the time that our oil supply would be exhausted in 25 years.

Today we hear the Diesel-electric is the locomotive that will relegate the old steam engine to the scrap pile, and there are a few, mostly those

who have lost all hopes in steam and find that the Diesel required costly maintenance at times, who are awaiting the gas turbine as the ultimate in motive power.

We may rest assured the final choice of motive power will be that which satisfies the natural laws of economics—that provides the largest return on the investment. All charges against the investment and all costs of maintaining service included, modified only by considerations of public health, comfort and demands.

## Reducing The High Cost of Maintenance And Repair

We are faced with the serious problem of reducing the high cost of maintenance and repair of present day steam locomotives. Improvements in this direction, representing as they do the largest item of operating cost, have not kept pace with improvements in performance. One of our large railroad systems approximating 125 million locomotive miles a year reports a variation in repair costs of only three cents a locomotive mile, or about 12 percent in the past 20 years. The reason is apparent when it is realized that in many respects little has been done to improve the most common items requiring frequent repair or renewal. Improvements in economy, efficiency, and general satisfaction will follow automatically the elimination of the basic causes for high maintenance.

The shop must receive first attention. The steam locomotive is a fine piece of machinery. It required fine workmanship and good materials to condition it for its strenuous duties on the road, and to enable it to withstand the forces tending to tear it apart. Our high speed passenger locomotives must run like a sewing machine and the monstrous big fellows in heavy freight service must take their load without a murmur.

Steam locomotives have been with us so long that perhaps it never has occurred to some of us that the performance of these locomotives might benefit from the precision machine work and adherence to tolerance of the order found necessary for Diesels.

Therefore, a share of the money to be spent in repairing the damages to railroad equipment at large occasioned by the war should be spent in modernizing the shops and engine houses to provide the high quality and fine precision the steam locomotive demands and deserves. At the same time, the shops and engine houses might well be modernized so that the new tools and new methods may be used under improved working conditions that will insure the best workmanship.

Coming now to the approach to specific problems of locomotive maintenance those pertaining to the boiler are most urgent.

How shall the approach be made?—by the simply process of experimentation. Through the science of experiment, Roger Bacon who reached the peak of his greatness about 1240 A. D. said in dealing with experiment.

"There is one science more perfect than others, which is needed to verify the others, the science of experiment, surpassing the sciences dependent on argument, since these sciences do not bring certainty, how-

ever strong the reasoning unless experiment be added to test their conclusion. Experimental science alone is able to ascertain what can be effected by nature, what by art, what by fraud."

To plan an experiment aimed at curing or greatly improving a particularly troublesome fault an assumption must first be made as to the cause of fault. We must assume rather than opine. As assumption is the basis of experiment to prove or disprove the assumption, an opinion leads only to argument and often to hard feelings.

In dealing with the causes of high boiler maintenance, cracked side sheets, boiler cracking, cinder cutting, pluggings, scale, poor steaming, and the like, an assumption must be made in each case upon which to base a logical series of experiments to bring out the facts. In some cases this has been done for us but we refuse to accept the findings as facts so we must do them over again that we may be convinced.

A notable example is the work done by Dr. W. C. Schroeder of the U. S. Bureau of Mines in the facts developed through painstaking work in the laboratory and in boilers in service establishing the causes for the cracking of boilers. He has proven beyond reasonable doubt that three conditions must be satisfied for failure to occur. These he defines as follows:

1. Leakage that will allow concentration of the water in seams or other areas of the boiler.
2. Stress in the metal in contact with the concentrated solution.
3. An embrittling boiler water.

He has done vastly more than tell us why cracking occurs—he has established a means to prevent cracking in many existing leaky boilers fed with embrittling water through the use of inhibitors.

The economically sound progress to higher steam pressures immediately comes up against the limitations of riveted boilers. The higher the pressure and hence the operating temperature, the more difficult it is to take care of boiler cracking by the use of inhibitors in certain kinds of water that must be used on some divisions. Unfortunately the high strength steels irrespective of composition do not provide relief from this difficulty as has been well proven.

Nor will boiler water treatment solve this problem. This statement does not belittle the contribution that water treatment has made to keeping locomotives on the road especially during these past war years. Without it our transportation system might well have bogged down. The transition of water treatment from an art to a science has been easier to accomplish in the treatment of water for stationary boilers than in locomotive boilers because of the many uncontrollable variables in the divergent water supplies for the latter. Consequently, the treatment of locomotive boiler water still retains more of the characteristics of art than science.

To the extent that proponents of secret water treatment have diverted attention from other angles of the boiler cracking problems to this extent they have contributed to the delay in applying more effective remedies related to better materials and methods of construction.

This brings us to the means of curing the particular type of failure associated with leaks—welding. Thus we eliminate in a single step, once and for all time, one of the three prerequisites for failure as laid down by Dr. Schroeder.

It seemed logical to apply the same reasoning to the cracking of side sheets. It was, therefore, assumed that leakage of staybolts was the primary cause of cracked side sheets. The assumption was based on the facts developed by Dr. Schroeder.

The arguments in favor looked so good to one of our Eastern railroads that approval was given to apply the construction in four locomotives, later extended to six, of a class, operating in the same service on one division. The conditions for test were ideal, staybolt leakage becoming excessive at about 15,000 miles, numerous dumps were made for calking, then staybolt renewals when calking was no longer effective, and finally side sheet renewals at an average life of about 45,000 miles.

The first locomotive in the series of tests has been in service two and a half years and has accumulated a mileage in excess of three times the previous average life of side sheets. The next two required renewal of side sheets at 25,000 miles due to cracks as the result of leaky staybolts. The fourth was made leak-proof and has been in service since April 1943 with over double the average life to date. The fifth went in service in January of last year with conventional construction and the side sheets were renewed in July. The sixth is leak proof with ........ miles to date without requiring attention to the side sheets.

The staybolts in the first of the series were applied in the conventional manner but under strict supervision. Those in the second, third and fifth which required side sheet renewals were applied in the conventional manner without special supervision and those in the fourth and sixth were seal welded.

The pertinent facts learned from these tests are:

1. Staybolt leakage is the primary cause of cracked side sheets.
2. It is possible to obtain leak proof staybolts by the conventional method of screwing through and riveting over the ends but only under strict and constant supervision.
3. Seal welding is a reliable and immediately available means for obtaining freedom from leakage.

The trials on seal welding which now include a dozen or so combinations in over 20 locomotives on five roads, two in Canada and three in the United States are proving the advantage of tight staybolts in reducing and possibly eliminating the maintenance involved in calking leaks, renewing staybolts, patching and renewing side sheets. In fact, no maintenance has been required in any of the seal welded applications. From the facts now at hand it is safe to assume that seal welding, without any other change, will double the life of side sheets.

Later we expect to have available a cheaper and faster method for setting staybolts by means of explosive charges. Experimental work has been restricted on account of the war but is now going forward again.

## Staybolts

The successful use abroad of Monel rigid type bolts in the breaking zones beginning with the first trial made 30 years ago leads to the assumption that the Monel rigid type bolt can displace to decided advantage the present iron and steel bolt articulated at the wrapper sheet end with a ball and socket joint.

As rich as the English language is, we seem to have difficulty in expressing what we mean in applying names to staybolts. The rigid type bolt is not rigid, the flexible bolt is flexible on one end only and, not to be left behind, we will call the Monel rigid type bolt, elastic and coin the word "Monelastic" to describe it fully.

A Canadian road has the distinction of being the first on this continent to apply "Monelastic" staybolts throughout the breaking zones of two new boilers to displace the flexibles that would normally have been applied had conventional practice been followed.

To them this application is experimental and it called for courage, to us it is not so much of an experiment in view of the facts gained through the use of millions of Monel staybolts abroad.

The virtue of Monel staybolts lies in their ability to withstand the combination of stresses and corrosion that cause breakage of steel and iron bolts.

## Cinder Cutting & Plugging

Cinder cutting and plugging are treated together, though they do not necessarily occur together, both seem to be due to the same cause. Improper combustion. At least that is our conclusion from the facts at hand.

Unburned coal of an abrasive nature carried in large amounts in the gases moving through the boiler at abnormally high velocity is the obvious cause of cinder cutting. When the unburned particles are able to collect as a sticky mass at high temperatures plugging is the result. Both cinder cutting and plugging represent such a huge cost for maintenance and repair that expenditure of large sums to effect a cure is justified. The solution calls for drastic and energetic action and may involve radical changes in the entire related system of combustion and boiler design.

Reams have been written on the influence of combustion on boiler performance. Valuable test data have been collected and published. The Pennsylvania Railroad and the New York Central are to be commended particularly for the contributions they have made in their plant and road tests.

The principal objective has been to get the most work possible out of the boiler and engine without regard to maintenance and with little regard to fuel saving. Lacking an incentive to improve on the basis of efficiency and fuel conservation it is hoped that the incentive may be found in the need for reducing the cost of maintenance and for increasing availability. Had these factors been given more attention in years past it is a good guess that the Diesel-electric would not have made as rapid progress as has been witnessed during the past ten years.

The study involved two phases:

1. Improving existing power—and
2. Incorporating in new designs the salient features for improved combustion learned from further studies and experiments.

Drafting seems to be the first line of attack. In spite of the immense amount of work done there is room for improvement. The present scheme of inducing a draft by entraining the flue gases in a stream of exhaust steam at velocities high enough in some cases to carry them through the stack to heights of 30 or 40 feet has but one redeeming feature—simplicity. The fixed nozzle whether single or multiple is at best a compromise. It is a good compromise when the results are good and they have been good in enough cases to establish the fixed nozzle as standard. A departure must be made from the ultimate in simplicity in those boilers where cinder cutting, plugging, and inadequate performance is experienced. This might involve the use either of induced fan draft or adjustable nozzles.

A cure, however, cannot be effected from changes made only in the front end. With each change in drafting, changes must be made in the grate opening, the arch, firing practice and the like to obtain optimum combustion for the particular coal used. Over-fire air is likely to prove essential and though first trials may be made with cold air injected by means of steam jets, it is practically certain that heated air with blower admission will be the final choice.

The use of pulverized coal should receive early attention as a means to reduce maintenance and repair of tubes and flues—and to increase further the horsepower delivered by the boiler at full load.

## Split Tubes & Flues

Failures due to split tubes, cracked ligaments, and excessive leakage at the rear tube sheet may be attributed to overheating associated with adherent water scale. Nickel-clad steel tubes and rear tube sheets offers great promise as an effective and economical means to maintain the evaporating surfaces free from scale and hence reduce the enormous stresses resulting from the differential thermal expansion of the tubes in respect to the barrel of the boiler and between adjacent open and plugged tubes. An experimental installation of a nickel-clad steel rear tube sheet with complete installation of nickel-clad steel safe ends will be made shortly by a Canadian road. The application of the nickel-clad rear tube sheet and nickel-clad safe ends with a better means of applying the tubes and flues may prove to be sufficient—if not, then a complete installation of nickel-clad tubes and flues with a nickel-clad rear tube sheet is planned as the ultimate step.

Nickel-clad evaporating surfaces including the firebox, tubes and flues should provide even better operating conditions for boilers operating at the highest pressures in use at the present time, 300 to 325 psi. than is obtained with the most perfect water treatment alone for 225 psi. and lower. Nickel-clad should provide the means to obtain reliable

service at working pressures above those used at present 400, 500 psi. and higher which can be expected in the near future.

### New Boiler Designs

A mass of work has been done on boiler design and a mass remains yet to be done. A radical departure is proposed involving the change from the fire tube to the water tube design for pressures up to 800 psi. The outside limit of 350 psi. which is generally accepted for the present day conventional boiler is optimistic considering the limitations imposed by riveted seams, staybolting practice, scale, and other inherent features of the boilers today. These things can be changed and with the changes, new higher limits in working pressures and capabilities are possible.

The steam turbine is almost certain to displace the reciprocating engine to a large degree which will lead to higher pressures and higher superheats. The demand, however, for a better boiler is no more urgent for the coming steam turbine locomotives than it is for our present day reciprocating engine driven locomotives and these will be with us for many years to come.

The future holds great promise for the steam locomotive—great promise for the coal burning steam locomotive. The war has imposed the greatest load in history on our railroads and the almost impossible task is being accomplished with efficiency and dispatch. The first credit naturally goes to the army of men and women in all branches of railroad service who through their efforts and loyalty are keeping the trains moving and the next credit goes to the steam locomotive—the important prime mover of the entire system of transportation.

### The Steam Locomotive of The Future

Predictions of things to come can be made freely by anyone. If they come true you are a prophet, if not your prediction is forgotten. I should like to indulge in a prediction of the steam locomotive of say 25 years ahead. Economical to operate and easy to handle. Turbine driven in both direct and electrically connected models operating at a steam pressure of 500 psi. or thereabouts at steam temperature of 800 to 900°F. Roller bearing equipped throughout—a welded boiler of low alloy steel such as 2 percent nickel—minimum tensile strength 75,000 psi.—fire tube on combination fire and water tube with staybolted firebox designed especially for pulverized coal firing.

An evaporating surface to which scale will not adhere, such as nickel —fire-box stayed with reduced body rigid type staybolts made of a material capable of being stressed under boiler pressure to 15,000 psi. if necessary and be free from breakage, such as Monel.

A superheater, of advanced design, readily accessible—efficient—offering a minimum resistance to the flow of steam and furnace gases.

Pulverized coal hoppers of ample capacity out in front—then the cab with green air-foam seats for the engineer and fireman with push button controls for the semi-automatic operations. Most operations, how-

ever, will be fully automatic. Behind the locomotive will be coupled the condenser car which will also house the fly ash collector, most of the auxiliaries and a small tank for make-up water for those locomotives operating in regions of high priced coal. For non-condensing locomotives the tender fitted with water scoop operating automatically by means of "electric eyes" will carry the fly ash collector and other auxiliaries.

Ample booster power will be provided to enable these locomotives to start and accelerate the trains smoothly and rapidly. A steam turbine booster either direct or electrically connected has possibilities.

Free from reciprocating parts and amply cushioned on rubber—running on a track with welded joints—this visionary locomotive will operate at high speed without vibration, shock, smoke, dirt, fumes, or noise other than the pleasing rumble of the wheels.

# Locomotives of The Union Iron Works

By Gilbert H. Kneiss

Ask a person devoted to locomotive history about the Irving Scott engines and the chances are he will meet you with a blank stare. Mention the Booth locomotives, however, and he will recognize them at once as products of the Union Iron Works of San Francisco in its golden days. Yet without any disparagement toward Mr. H. J. Booth who was an able pioneer industrialist in his own right, the fact is that he had considerably less to do with the locomotives in question than did Irving Murray Scott. But let us start at the beginning, which is Peter Donahue.

In 1849 almost everyone in San Francisco wanted to go and dig for gold. Few were interested in making the necessary tools to do the digging. Peter Donahue had tried digging without success so he and his brothers opened a small forge under a tent and named it the Union Iron Works. It was a pretty crude affair. Their furnace was the smokestack of a dismantled steamer, their blast produced by two blacksmiths' bellows. Nevertheless, it was the "best in the west" and business boomed.

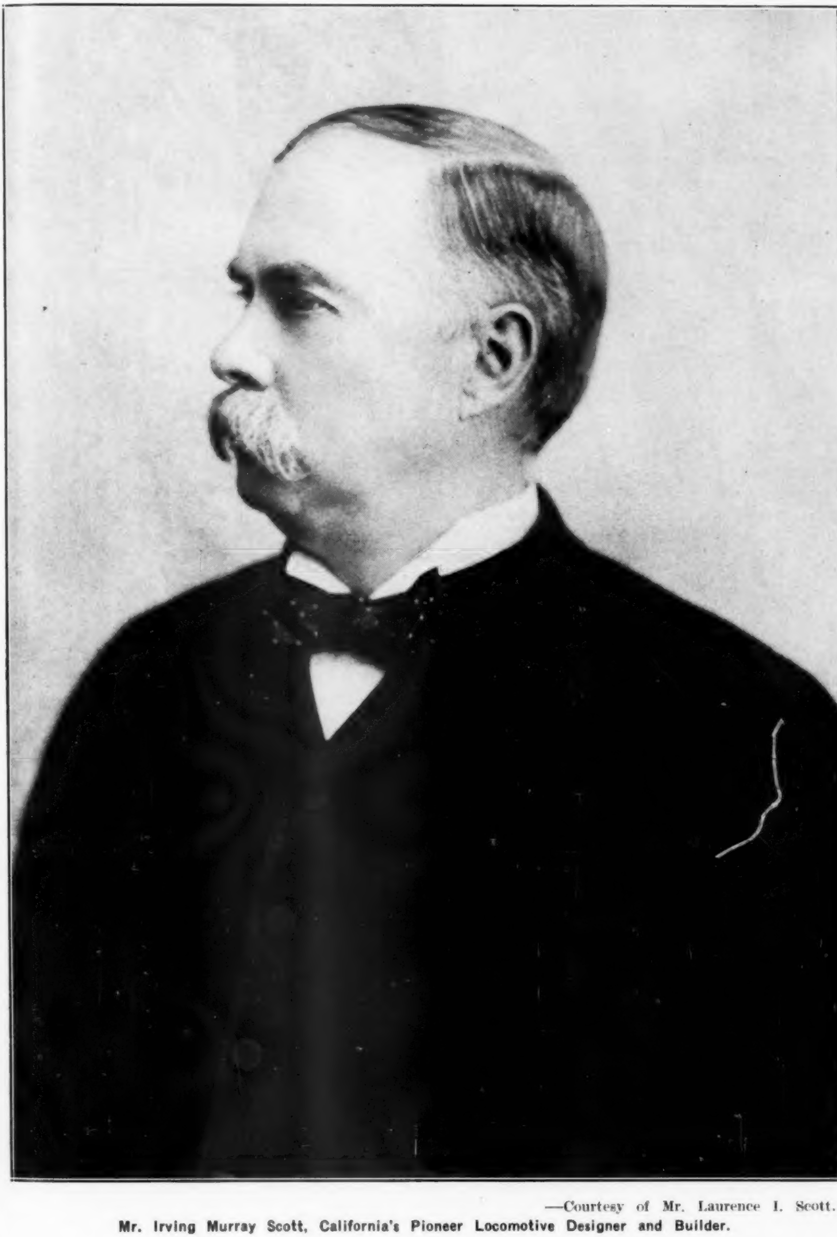
Donahue and his brothers were well qualified to found San Francisco's first iron works. Glasgow born, they had spent their younger childhood days toiling in the horrible sweatshops of that period. Peter was only eleven in 1833 when the family sailed for America. A few years later he was apprenticed to the Union Iron Works of Paterson, New Jersey as a student machinist. His two brothers were bound to the same concern, James learning boilermaking and Michael becoming a molder. It was this firm's name which they later applied to their own enterprise.

In 1845 Peter was employed on the construction of a gunboat for Peru and sailed aboard her on her maiden voyage to South America. There he might have stayed but for the cry of "Gold" that echoed out of California and changed so many men's lives. The fall of '49 found him in San Francisco welcoming two "tenderfeet"—his brothers.

The tent was soon outgrown and a new location found in "Happy Valley" on the site of the present Bridge Railway Terminal. By 1856 Peter Donahue had bought out his two brothers' interests and erected a substantial brick foundry and machine shop.

However, the days when business rushed in of its own accord passed. Competition increased. Donahue gradually interested himself in other matters which took more and more of his time. The Union Iron Works began to languish.

The decline was most distasteful to Irving Scott, Donahue's draftsman. This young Quaker had made the long journey to California with high hopes of a successful career in his profession of mechanical engineering. He had prepared himself well. Born Christmas Day, 1837 at Hebron Mills, he had gone to work at seventeen in the plant of Obed



—Courtesy of Mr. Laurence I. Scott.

**Mr. Irving Murray Scott, California's Pioneer Locomotive Designer and Builder.**

Hussey, inventor of the reaping machine. After three years there he switched to the Murray & Hazelton Iron Works in Baltimore. Soon he was in charge of stationary boiler and fire engine production. And in his spare time he studied drafting. In 1860 the chance had come to go with Donahue in California and he had eagerly grasped it. But the way things were going now, he saw no future in the Union Iron Works.

The Miners' Foundry, two blocks down First Street, on the other hand, was booming. Quartz mining machinery was its specialty and the Comstock Lode offered an insatiable market. Scott became the Miners' Foundry draftsman in 1862. He found it unique among industrial organizations of that day. All twenty of the skilled workmen were full partners with the actual owners of the plant. After the owners had received their dividends at a fixed rate the balance of the year's profits were divided among the workmen proportionately to their salaries.

But in another year Scott was back at the Union Iron Works. Peter Donahue had brought H. J. Booth into the company to put it back on its feet. Booth had been a partner in the Marysville Foundry, one of the largest in the West, and Scott thought, on the basis of past performance, that he would have the Works humming again in short order.

But two years under the new firm name of Donahue, Booth & Company brought no improvement. Peter Donahue, disgusted, retired from active management in the firm in 1865 and Booth brought in George W. Prescott who had been his partner in the Marysville Foundry. And now Irving Scott's ability was rewarded with a full partnership and the job of general manager. Now indeed he had the opportunity for which he had come west.

As H. J. Booth & Company the Union Iron Works now took a new lease on life. The working force was increased to 300 men and new machine tools installed. Organization and system were introduced for the first time. Each man was given a brass check with his number on it. When he reported for work in the morning he hung it on a corresponding peg, and from the missing tags it could be seen at a glance who was absent or tardy. On returning from lunch at one o'clock the men retrieved their tags—then those which still hung on their pegs when the whistle blew showed the offenders.

A regular apprentice system was installed, boys of seventeen being bound in for a four year course. They received four dollars a week during the first year and were stepped up to ten dollars by graduation. Usually they worked out better than experienced workmen from the East. They were proud of the Union Iron Works—there was a good feeling among all hands. Irving Scott was a good manager.

One of the outside interests which had diverted Peter Donahue's attention from the Works was the San Francisco & San José Railroad. This line had been opened for service as far as Mayfield in 1863 and completed to San José the following year. Motive power consisted of two Norris locomotives and one Mason. Good enough engines for the times, they had been a disappointment on the heavy grade out of San

Francisco. Donahue and Scott saw no reason why the Union Iron Works couldn't build them as well or better.

So Irving Scott, with little if any direct railroad experience behind him, set out to design a superior locomotive. He was familiar with steam from the fire engines and stationary boilers he had designed in Baltimore. And although there is no evidence, it would indeed be strange if such a man had not spent many inquisitive hours in the B. & O. shops nearby.

At any rate, when the designs lay completed on Scott's drafting board they looked good. The San José road ordered two locomotives built from them and the Sacramento Valley Railroad signed up for a pair as well. Construction was started.

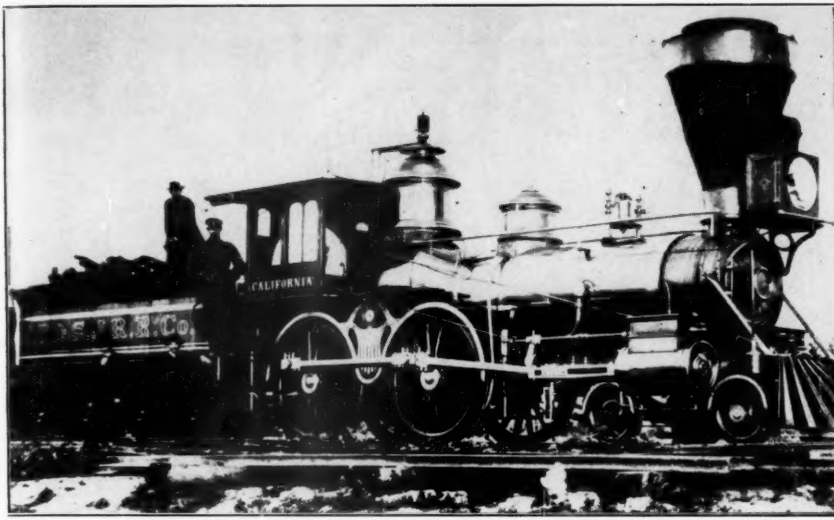
There was a good bit of excitement in San Francisco about this venture. William Ralston was in the midst of starting his many projects—all designed to make California industrially independent of the East. There was widespread enthusiasm about this conception of things and the Union Iron Works was going right along with the spirit of the times. No locomotives had heretofore been built in California, with the exception of a couple of tea-kettles assembled for suburban service. These would be full size giants of the rails—equal to anything the world had seen.

There was, accordingly, a sizable crowd on hand August 1, 1865 when the "California," first completed of Scott's locomotives left the Works. Twenty strong drayhorses dragged her through the city streets some eight or ten blocks to the railroad. It was not an easy journey. Many times the heavy engine sank to the axles in the soft pavement and hydraulic jacks were called upon to lift her out and on her way. The delighted crowd which included most of the small boys in town followed, shouting bits of unappreciated advice to the perspiring teamsters. Finally the locomotive was deposited solidly on the rails at Townsend Street.

A few days later the "California" was to prove her mettle. With utter confidence in their handiwork, Irving Scott and his associates had invited 150 guests to a trial trip. Governor Stanford, who would need many engines for his Central Pacific was among them. Steaming proudly, the untried engine bore close scrutiny and listened to approving comment as the party gathered.

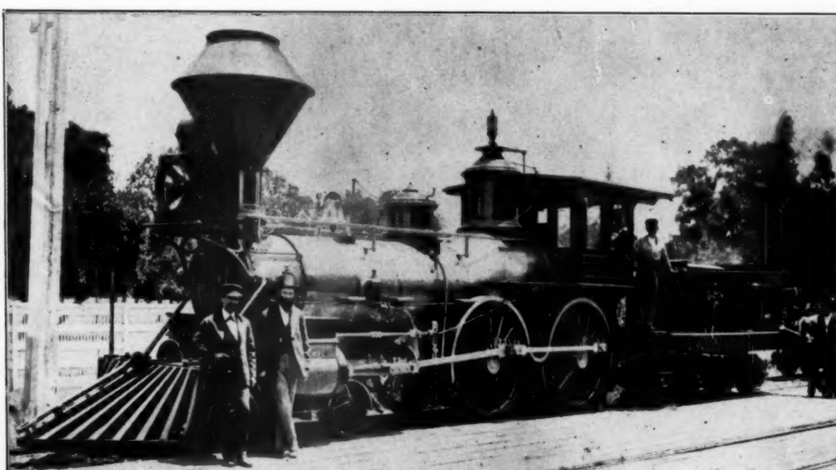
The shining locomotive and her builders had full right to their pride. The "California" stood sixteen feet tall to the top of her balloon stack and from pilot tip to tender drawbar she measured 42 feet. Of the standard American 4-4-0 type, her 60 inch drivers promised speed. Wooded and watered, she weighed 46 tons and her lines, while distinctive, equalled in proportion and gracefulness the finest output of the East. And she had cost less than an eastern engine plus the freight.

With the guests in four San Francisco built coaches, the "California" pulled away from the depot at 10:40. Running easily along Brannan Street and through the Mission, she hit the steep grade out of town. Her throttle a few notches wider, she conquered it without losing speed. Back in the coaches the guests looked at each other in




—Collection of Gilbert H. Kneiss

U. I. W. #1; (S. F. & S. J. R. R. #6, "California")



—Collection of Rob't. H. McFarland.

U. I W. #2; (S. F. & S. J. R. R. #7, "Atlantic")

amazement. The summit grade had always been a severe trial to the Norris engines.

At Twin Trees, now Palo Alto, the excursionists picniced, danced, and listened to complimentary speeches about the "California." Booth responded for the Works and it was time to start the homeward journey. Between Twin Trees and San Mateo the train ran at 67 miles an hour. It was a speed never before experienced west of the Rocky Mountains. The "California" was, most definitely a success.

A few weeks later her sister engine "Atlantic" joined her on the San José road. The Sacramento Valley Railroad, however, had passed to Central Pacific control and its projected Placerville and Washoe extension was an exploded dream. The two locomotives the S. V. had ordered from the Union Iron Works were intended for the Placerville-Virginia City run and now no engine would ever make that journey. The Central Pacific cancelled the order for one engine on which work had not yet begun, but accepted the other, U. I. W. No. 3. "A. A. Sargent" they named her, after the California congressman who had introduced the Pacific Railway bill.

With three successful American 4-4-0's in service on two first class railroads the Union Iron Works was fairly launched as a locomotive builder. However, the next orders which came in were for an entirely different type of engine. Irving Scott got out his drafting instruments again.

Some forty miles east of San Francisco a flourishing coal mining community had grown up on the north slope of Mount Diablo. The vein was promising and several mines were in operation. Three parallel railroads were being constructed to carry the coal down to the San Joaquin River about five miles away. Here it would be loaded on river steamers for San Francisco and other points. These railroads were known respectively as the Antioch Railroad, the Pittsburg Railroad, and the Black Diamond Railroad. They all had the same general characteristics; a straight gentle slope leaving the river bank but running into steeper and steeper grades with tortuous curves as the mines were approached. Maximum grades were more than 5%.

They would be difficult roads to work despite the shortness of the run. What was needed was maximum power for heavy hauling of mine supplies uphill without much concern for economy of operation, as the native coal was to be used for fuel.

To handle this assignment Irving Scott designed a class of six-coupled tank engines with short boilers and large tubes. They had 86 tubes, 2¼ inches in diameter and 7 feet long. The total heating surface was 421 square feet. Cylinders were 14 by 18 inches and the engines were operated at less than 100 pounds pressure. Drivers were 36 inches in diameter, the center pair being blind.

During a test run only 2.42 pounds of water were evaporated per pound of coal due to the short wide tubes and the sharp blast required. Nevertheless they were well adapted to the job and attracted notice as far away as London, where they were written up in *Engineering*. Five of the class were built during 1866 and 67, three for the Pittsburg Rail-

road and two for the Black Diamond line. Motive power for the third road, the Antioch Railroad, was built by Marschuetts & Cantrell, a small San Francisco foundry.

During this period another locomotive left the Union Iron Works for the San Francisco & San José, an 0-4-0 switcher named "Union." This engine was particularly designed for very sharp curves, her wheelbase being only 6 feet 4½ inches. She had cylinders 16 by 18 inches, 48 inch drivers, and operated at 120 pounds steam pressure.

In 1869 another 4-4-0 was turned out for the California Pacific and then Booth secured a contract to furnish part of the initial motive power for the Virginia & Truckee Railroad. This job called for another design from the drawing board of Irving Scott. The V. & T. would be a rough and crooked line and the booming mines of the Comstock Lode meant constant tonnage hauling. From Virginia to Carson City the line was a succession of hairpin curves with radii running down to 120 feet and there was a constant grade of over 2% for the entire 24 miles.

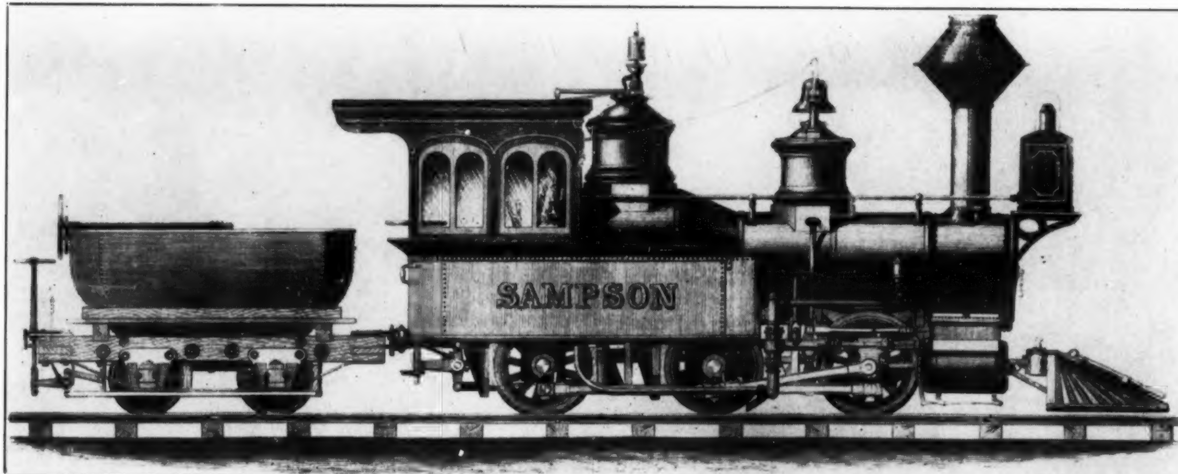
Good steaming and maximum tractive effort were essential. Scott's design to cope with these conditions was a 30 ton mogul, nearly all of whose weight was carried on the drivers. The leading wheels were connected to a Bissell truck, the forward center of which was in turn connected to a swing beam, enabling the engine to follow the curves easily and relieving the flanges of the front drivers. The total wheelbase was 16 feet, the center pair of drivers being blind. Cylinders were 14 by 24 inches. There were 170 2-inch tubes and the total heating surface was 960 square feet. Wood was the fuel.

Three of these locomotives were built and christened respectively "Lyon," "Ormsby" and "Storey" after the Nevada counties through which they were designed to work. They were run up to Reno on the Central Pacific under their own steam and there their rods were disconnected, tenders uncoupled, and all wheels fitted with broad extra tires to protect their flanges. Thus equipped, ten yoke of oxen dragged each one up hill and down dale, fording creeks as they found them, away to Carson City.

In the new shops of the V. & T. they were restored to normal. Soon they were working on construction trains and later hauling heavy loads of ore or mine timbers around the screeching curves that hardly ever had time to cool off between the constant trains.

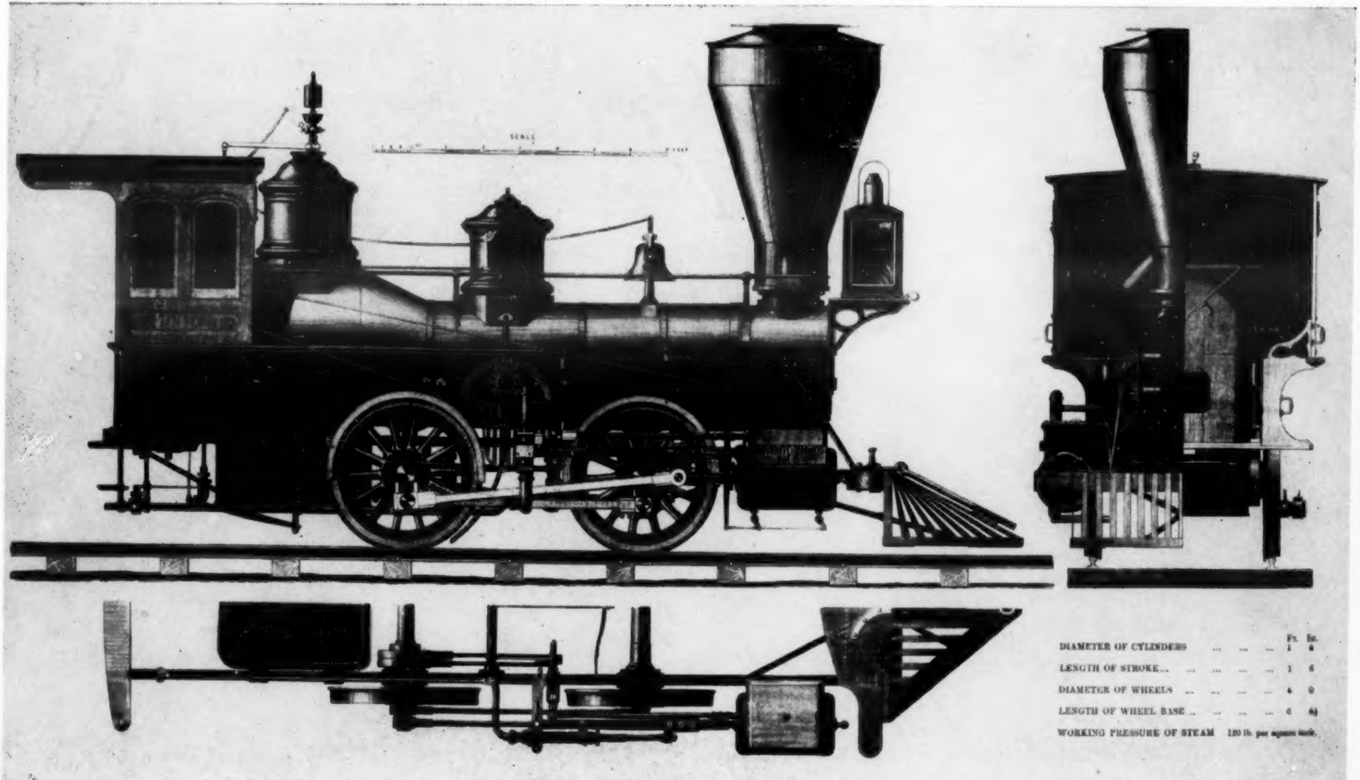
The Virginia & Truckee Railroad developed into a heavy locomotive purchaser for a short line but it bought no more engines from the Union Iron Works. The reason why is not apparent as the three it had were all very successful machines. Two wore themselves out on the V. & T. and were finally scrapped, but the "Storey" had a varied and long career.

In 1881 she was sold to A. Onderdonck, manager for D. O. Mills & Company on the British Columbia section of the Canadian Pacific construction. When the work was done she was turned over to the Canadian Government with the road and the rest of the contractor's rolling stock. However, when the Government in turn delivered the road to the Canadian Pacific Railway Company it retained title to the locomotives and




U. I. W. #4; (Pittsburg R. R. #1, "Sampson")

—From London Engineering




U. I. W. #6; (S. F. & S. J. #8, "Union")

—From London **Engineering.**

cars. In 1887 the "Storey," now known as "Yale," was sent to the Intercolonial Railway in Nova Scotia and was still puffing around in 1920 as Canadian National #7082.

But to get back to Irving Scott and the Union Iron Works. Peter Donahue was now building another railroad, the San Francisco & North Pacific. From Tiburon, across the Bay, the new road would run north through prosperous farm and dairy country into the redwood belt. What was more natural than for the "Donahue Line," as it began to be known, to buy its motive power from the Works that its owner had founded and in which he still maintained a substantial interest?

Three locomotives were built for the S. F. & N. P. in 1870—the "J. G. Downey," "W. C. Ralston," and "Geyser." In 1873 another, the "Santa Rosa" was turned out. Finally, to jump ahead a bit, Irving Scott's last engine, the "Ukiah" was delivered to the Donahue line in 1882. All five were 4-4-0's, very much like the original "California" with the refinements that experience had indicated.

Thus by 1873 the Union Iron Works had turned out seventeen locomotives in eight years. Not an impressive figure when compared with Eastern builders, but still very respectable for remote San Francisco. The product was good and it was accepted. There seemed every reason to expect the Union Iron Works to become an important locomotive manufacturer. To quote from its 1873 "Circular and Pattern List":

> "It may well be doubted if there is any branch of the manufacturing of machinery which imposes greater responsibility upon the builder and at the same time taxes his mechanical skill to a greater degree than the construction of locomotives. Strength, durability, speed, perfect proportions and beauty are demanded at his hands. Upon a single beam, bolt, tie or spring may hang the lives of a multitude. This branch of business on the Pacific Coast has, thus far, been entrusted almost or quite entirely to ourselves and it is with pride that we point to the results of our labors, confident that no country produces better. With the desire to produce a first class engine we have corrected every defect as fast as circumstances would allow and added all the improvements that have stood the test of usage. We are now prepared to furnish the following sizes as cheaply and of as good a quality as can be obtained elsewhere."

Certainly a modest, sincere sales talk and one that arouses confidence by its lack of extravagant claims. The "following sizes" were essentially a resume of the engines turned out and were listed as follows:

"1. Our passenger engine (4-4-0). We have patterns for this style of 14 inch cylinder diameter and 22 inch stroke and 15x22 with five foot driving wheels each.

"2. A heavier engine (4-4-0) 16x24. Five foot drivers. Freight or passenger.

"3. Our heavy freight engine (2-6-0). Designed for grades of 116 feet per mile and short curves. Has six-coupled wheels and only enough weight on truck to take side wear off flanges

of forward drivers. Cylinders 16x24. Drivers four feet. Truck wheels 26 inches. Also have patterns 14x24 and 40 inch drivers.

"4. Our freight engine designed for drawing load of 100,000 pounds beside itself up grades of 300 feet per mile (0-6-0T) or four wheel tender). Cylinders 14x18, drivers 36 inches. Designed for Mount Diablo Coal Mines where they are now running to the satisfaction of the Pittsburg and Black Diamond Railroad companies.

"5. Our shifting engine (0-4-0) 14x18. Drivers four feet.

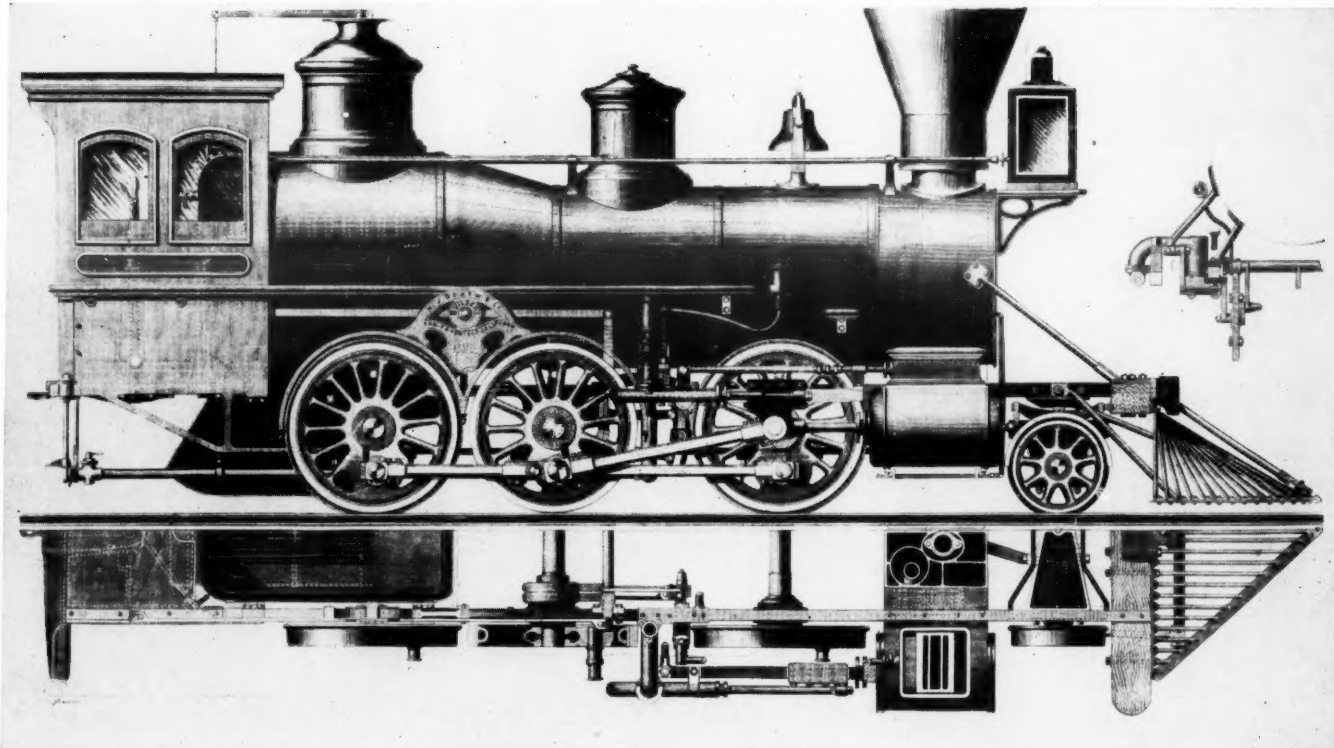
"6. Fairlie engine and narrow gauge (0-4-0-0-4-0). Cylinders 8½x13. Drivers 39 inches."

No evidence has come to light that any Fairlie engines were actually constructed. All of the other types, however, were as we have seen, in successful operation. It therefore becomes difficult to understand why, with this encouraging start and responsible standing, the Union Iron Works apparently built no more locomotives for almost a decade. (Two serial numbers, 18 and 19, I have been unable to account for, and they may have been produced in this period. They may have been Fairlies too.) Were the Baldwin and the Mason salesmen too energetic, romping away with all the orders or was Irving Scott leaning too heavily toward shipbuilding to retain his interest in locomotives?

In June 1875 the firm changed again. H. J. Booth retired and the partnership became Prescott, Scott & Company. At last Irving Scott was recognized in the firm name. Though no locomotives were being turned out the Union Iron Works prospered with other business. Six hundred men were now employed. Orders were coming in from the navies of the world for marine engines and it began to be evident that with a new location on the shore of the Bay a great shipbuilding industry could be developed.

There was another short intense flurry of locomotive building in 1881 and 82. Eleven engines were built in those two years, mostly small narrow gauge jobs for lumber and mining roads. Notable among the engines produced in this latter period were a 5 foot 8½ inch gauge 4-4-0 for the Gualala Railroad, a redwood line in northern California, and two very snappy little narrow gauge Americans for the new Ferrocarril de Acajutla á Sonsonate in the republic of El Salvador. In spite of their neat lines a contemporary Salvador newspaper dismisses them as "American engines with little power and constantly requiring repairs." Research would probably disclose that the disparaging sheet was owned by British capital interested in seeing that Central American governments bought English locomotives, as one of the pair, the "Francisco Camacho" remained in active service until 1920.

The earlier Union Iron Works engines carried a very elaborate builder's plate in the form of a large Union shield between the drivers. In addition they bore a small plate on the valve chest with the words "H. J. Booth & Co." and the serial number. After the firm changed in 1875 a small round plate on the smoke box with "Prescott, Scott & Co., San Francisco, Builders," the year and serial number was substituted.



U. I. W. #13; (V. & T. R. R. #3, "Storey")

—From London **Engineering**

But now the locomotive building days of the Union Iron Works were coming to an end. Two years before, Irving Scott had toured the world, visiting and carefully inspecting every shipbuilding plant of any consequence. The Works had always been close to the sea. The first job turned out in Peter Donahue's tent back in 1859 was a ship's propeller bearing. The plant had built the engines for the sloop of war "Saginaw" built of California laurel during the Civil War. It had likewise assembled the monitor "Comanche" sent by President Lincoln to keep the Confederate Navy out of San Francisco Bay. But from now on it would build ships as well as power them.

In April 1883 construction started on the new Works on the shores of Potrero Point. Almost exclusively it would be a ship-building plant and thanks to the ideas picked up by Scott in his travels, one that was unexcelled in Europe or America. Sleek Pacific liners and grim ships of war would take form within its walls—but no more locomotives. The last one had been delivered from the old plant just before the move was made. Appropriately enough, it was the "Ukiah" for Peter Donahue's San Francisco & North Pacific.

At this late date there is little on which to base an accurate appraisal of the quality of Scott's locomotives. We know in general that they enjoyed a good reputation and that they were considered at least the equal of their contemporaries. In addition we find the following comparison with other makes in the 1890 annual report of the San Francisco & North Pacific Railway. This road then owned eighteen locomotives of which five were products of the Union Iron Works.

**San Francisco & North Pacific Railway**
**Locomotive Performance**
**1890**

| *Builder* | *No.* | *Av. Mileage* | *Av. Cost Per Mile* | *Av. Cost Repairs* | *Av. Total Cost Per Mile* |
|---|---|---|---|---|---|
| Norris | 1 | 10203 | 11.57c | $190 | 13.43c |
| Booth | 5 | 15501 | 12.80c | $315 | 16.81c |
| Baldwin | 1 | 32692 | 13.84c | $128 | 17.43c |
| Grant | 6 | 25320 | 17.68c | $969 | 22.66c |
| Rogers | 5 | 23421 | 20.67c | $676 | 24.57c |
| Total | 18 | 21634 | 15.78c | $679 | 18.90c |

From this table we see that the Booth or Union Iron Works locomotives operated at the lowest cost per mile with the exception of the solitary Norris engine. Furthermore, except for the Norris and the one Baldwin, the annual cost of repairs was the lowest of the group. Too much can not be guaranteed from such a compilation, yet what is shown is entirely favorable to the San Francisco built locomotives.

The Union Iron Works lived and grew and the Potrero Point plant, now a part of the Bethlehem Shipbuilding Corporation, is today still turning out ships to help win the present war. Without detracting in

any way from the honors due Peter Donahue, the pioneer founder; H. J. Booth; George Prescott and the others; Irving M. Scott deserves a lion's share of the credit for the sturdy growth and permanence of the enterprise. Designer of locomotives, builder of battleships and cruisers, shrewd business manager of a gigantic plant, he still found time to qualify in oratory, writing, and general civic welfare. Undoubtedly he ranks as one of the great characters in the history of building the West. His locomotives, admittedly one of his minor achievements, will always be remembered as graceful, dependable, efficient machines that had their romantic place in that colorful history.

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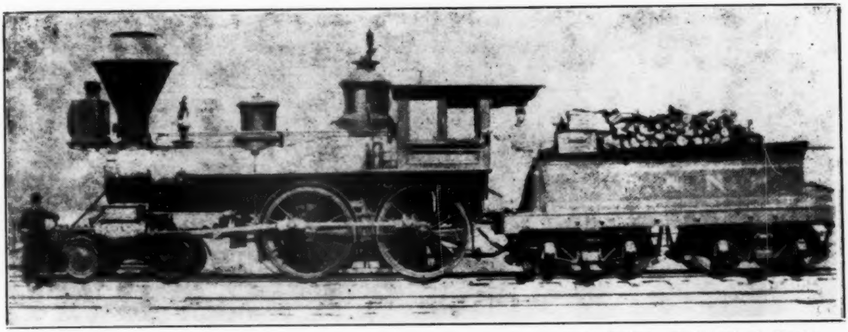
NOTE: The records of the Union Iron Works, as well as most of the other normal sources of primary material for an article of this kind, were destroyed in the San Francisco fire of 1906. I hope this fact will be kindly taken into consideration in connection with its shortcomings.

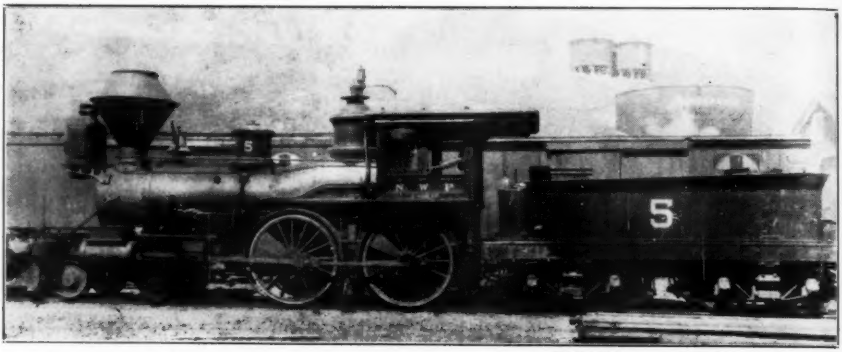


—Collection of Gilbert H. Kneiss

U. I. W. #14; (S. F. & N. P. R. R. #3, "J. G. Downey")

—Collection of Roy D. Graves.

U I. W. #16; (S. F. & N. P. R. R. #4, "Geyser")



—Collection of Gilbert H. Kneiss.

U. I. W. #17; (S F. & N. P. R. R. #5, "Santa Rosa") (Taken in 1904 when locomotive was N. W. P. #5)

—Collection of Roy D. Graves.

U. I. W. #30; (S. F. & N. P. R. R #11; "Ukiah")

## LOCOMOTIVES BUILT BY THE UNION IRON WORKS

| Ser. No. | Railroad | Name | Road No. | Type | Cyls. | Dvs. | Gauge | Year Built | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1 | San Francisco & San Jose | California | 6 | 4-4-0 | 16x24 | 60 | 56½ | 1865 | S. P. #1303, Rebuilt 1873, Scrapped 1911. |
| 2 | San Francisco & San Jose | Atlantic | 7 | 4-4-0 | 16x24 | 60 | 56½ | 1865 | S. P. #1231, Scrapped 1895. |
| 3 | Central Pacific | A. A. Sargent | 7 | 4-4-0 | 16x24 | 60 | 56½ | 1865 | S. P. #1214, Built for Sacramento Valley R. R. |
| 4 | Pittsburg | Mt. Diablo | 1 | 0-6-0T | 14x18 | 36 | 56½ | 1866 | |
| 5 | Pittsburg | Boston | 2 | 0-6-0T | 14x18 | 36 | 56½ | 1866 | |
| 6 | San Francisco & San Jose | Union | 8 | 0-4-0 | 15x18 | 48 | 56½ | 1867 | S. P. #1002. |
| 7 | Pittsburg | Sampson | 3 | 0-6-0T | 14x18 | 36 | 56½ | 1867 | |
| 8 | Black Diamond | ............... | 2 | 0-6-0T | 14x18 | 36 | 56½ | 1867 | |
| 9 | Black Diamond | D. O. Mills | 3 | 0-6-0T | 14x18 | 36 | 56½ | 1868 | |
| 10 | California Pacific | Calistoga | 2 | 4-4-0 | 14x22 | 60 | 56½ | 1869 | S. P. #1115. |
| 11 | Virginia & Truckee | Lyon | 1 | 2-6-0 | 14x24 | 40 | 56½ | 1869 | |
| 12 | Virginia & Truckee | Ormsby | 2 | 2-6-0 | 14x24 | 40 | 56½ | 1869 | |
| 13 | Virginia & Truckee | Storey | 3 | 2-6-0 | 16x24 | 48 | 56½ | 1869 | Became Canadian National Ry. #7082, see text. |
| 14 | S. F. & North Pacific | J. G. Downey | 2 | 4-4-0 | 14x22 | 64 | 56½ | 1870 | N. W. P. #7, Sold 1921. |
| 15 | S. F. & North Pacific | W. C. Ralston | 3 | 4-4-0 | 14x22 | 64 | 56½ | 1870 | N. W. P. #6, Scrapped 1912. |
| 16 | S. F. & North Pacific | Geyser | 4 | 4-4-0 | 14x22 | 64 | 56½ | 1870 | Scrapped 1900. |
| 17 | S. F. & North Pacific | Santa Rosa | 5 | 4-4-0 | 14x22 | 63 | 56½ | 1873 | N. W. P. 5, Scrapped 1909. |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | Sierra Flume & Lumber | | | 0-4-0T | 10x12 | 30 | 39½ | 1881 | |
| 21 | R. D. Chandler & Co. | | | 0-6-0T | 12x14 | 36 | 36 | 1881 | |
| 22 | Boca Railroad & Transp. | | | 4-4-0 | 14x22 | 62 | 56½ | 1881 | |
| 23 | Battle Mountain & Lewis | John D. Hall | 1 | 0-6-0T | | | 36 | 1881 | |
| 24 | Bodie Railway & Lumber | | 1 | 0-6-0 | 14x16 | 36 | 36 | 1881 | |
| 25 | Bodie Railway & Lumber | | 2 | 0-6-0 | 14x16 | 36 | 36 | 1881 | |
| 26 | Gualala | S. H. Harmon | 2 | 4-4-0 | 14x22 | 40 | 68½ | 1881 | Scrapped 1938. |
| 27 | Battle Mountain & Lewis | Starr Grove | 2 | 0-6-0T | 14x16 | 36 | 36 | 1881 | Sold to C. A. P. Ry. & Transp. |
| 28 | FC Acajutla a Sonsonate | F. Camacho | 1 | 4-4-0 | 12x16 | 36 | 36 | 1882 | Scrapped 1920. |
| 29 | FC Acajutla a Sonsonate | | 2 | 4-4-0 | 12x16 | 36 | 36 | 1882 | |
| 30 | S. F. & North Pacific | Ukiah | 11 | 4-4-0 | 18x24 | 60 | 56½ | 1882 | |

# The Hardwick & Woodbury Railroad

By John S. Kendall

For many years the towns of Hardwick and Woodbury in northern Vermont were famous for structural and monumental granite and, before the opening of the quarries at Barre, twenty miles south and over the mountain, the little town of Hardwick was the largest granite producing center in the world.

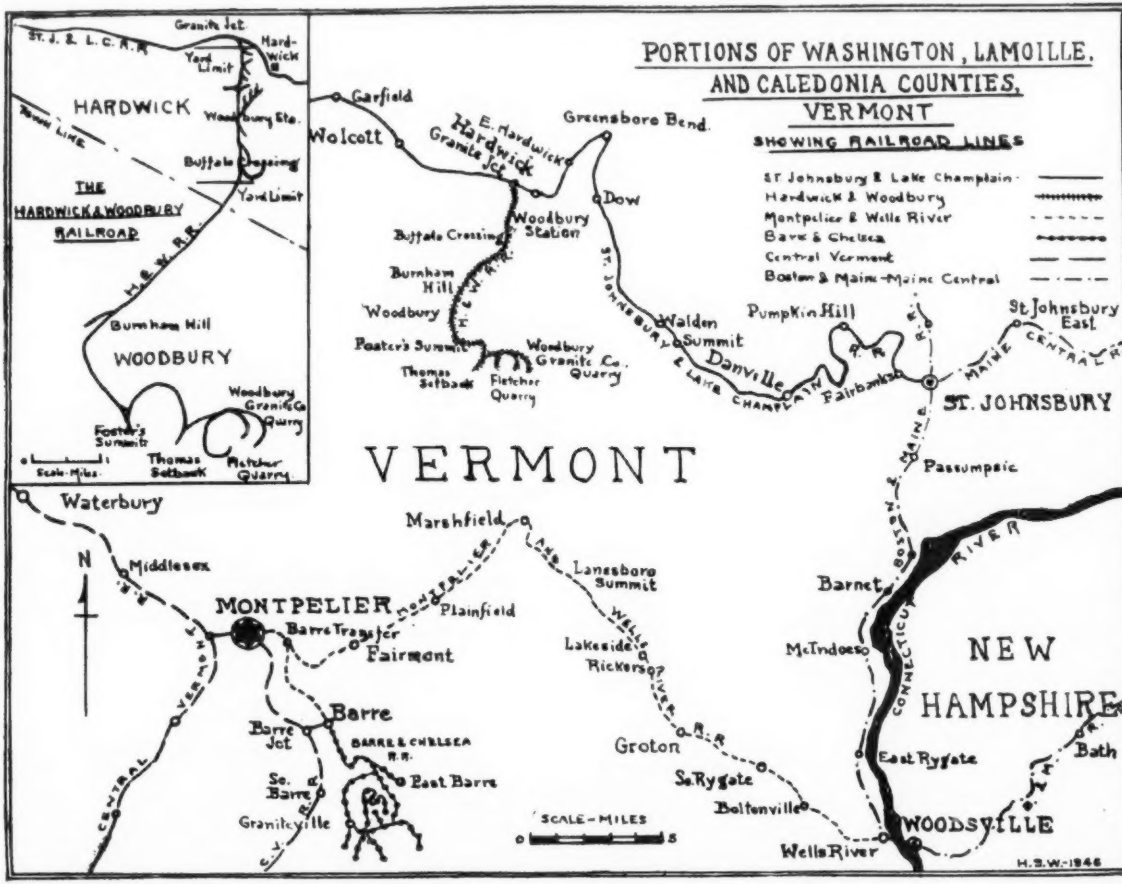
From the quarries south of the Lamoille River at Hardwick, or from those on the slope of Robinson Mountain in Woodbury, came the granite used in the construction of such buildings as the Pennsylvania State Capitol at Harrisburg, the Cook County Courthouse and City Hall in Chicago, the Bankers' Trust Company Building in New York, the Post Office in Providence and other well known public buildings in various parts of the country. In the monument field, the Woodbury Granite Company under the direction of Mr. George Bickford was noted for its fine carving and sculpture.

In recent years, however, the use of granite for structural purposes has been replaced by concrete, and the Barre quarries with finer grades of granite have captured much of the monumental business. As a result, many of the Woodbury quarries are closed while others in Hardwick operate on a curtailed basis, and the once busy Hardwick and Woodbury Railroad has gone the way of many similar railroads built to serve a single industry.

The Hardwick and Woodbury Railroad Company had its inception in the early '90s when the rapid development of the granite industry and the opening of the quarries on Robinson Mountain in Woodbury created a serious transportation problem. The only solution to the problem was the construction of a railroad from the quarries to the cutting sheds and the main line railroad at Hardwick. Preliminary steps for the construction of such a railroad were taken by the joint action of quarry owners and public spirited citizens in 1894 and on November 23rd of that year an act of incorporation was approved by the State legislature. This act was as follows:

STATE OF VERMONT LEGISLATURE

*Section 1* Such persons as shall hereafter become stockholders are hereby constituted a body corporate by the name of Hardwick & Woodbury Railroad Company for the purpose, and with the right, of building a railroad with single or double track and all necessary spurs, extensions, and side tracks, of such gauge or width as shall be deemed advisable, from some point on the St. Johnsbury & Lake Champlain R. R. in the town of Hardwick to the mountain quarry of the Woodbury Granite Company in the town of Woodbury, to transport and carry property on the same by power of steam or otherwise, and also to transport and carry passengers at its discre-



PORTIONS OF WASHINGTON, LAMOILLE, AND CALEDONIA COUNTIES, VERMONT
SHOWING RAILROAD LINES
St. Johnsbury & Lake Champlain
Hardwick & Woodbury
Montpelier & Wells River
Barre & Chelsea
Central Vermont
Boston & Maine-Maine Central
VERMONT
NEW HAMPSHIRE
CONNECTICUT RIVER
Garfield
Wolcott
E. Hardwick
Hardwick
Granite Jct.
Greensboro Bend.
Dow
Woodbury Station
Buffalo Crossing
Burnham Hill
Woodbury
Foster's Summit
Thomas Setback
Fletcher Quarry
Woodbury Granite Co. Quarry
Walden
Summit
Danville
Pumpkin Hill
Fairbanks
St. Johnsbury East
ST. JOHNSBURY
Passumpsic
Barnet
McIndoes
East Ryegate
Bath
WOODSVILLE
Wells River
Boltonville
So. Ryegate
Groton
Rickers
Lakeside
Lanesboro Summit
Marshfield
Plainfield
Fairmont
Barre Transfer
MONTPELIER
Waterbury
Middlesex
Barre
Barre Jct
BARRE & CHELSEA R.R.
East Barre
So. Barre
Graniteville
SCALE-MILES
0
5
N
H.S.W.-1946
THE HARDWICK & WOODBURY RAILROAD
ST. J. & L. C. R.R.
HARDWICK
WOODBURY
TOWN LINE
Yard Limit
Woodbury Sta.
H. & W. R.R.
Scale-Miles

tion, provided however, that said railroad company shall not be compelled to operate its line of railroad except in the months of April to November inclusive, in each year unless it shall elect otherwise to do; and by that name may sue and be sued, may have a common seal, and shall have all the rights incident to corporations.

*Section 2* Capital stock $50,000—may be increased if necessary.

*Section 5* As soon as 500 shares are sold, cause notice of election of directors.

*Section 9* If said company shall not within two years from the passage of this Act commence construction of the said road, and shall not within five years from the passage of this act finish the same, then this act shall be void.

*Section 12* The towns of Hardwick, Cabot, Marshfield and Woodbury may aid by subscription of stock or issuing bonds to aid.

The incorporators were L. D. Hazen, H. N. Turner, E. H. Blossom, T. C. Fletcher and G. W. Cree, all of St. Johnsbury; Congressman Powers, George Powers and Governor Hendee of Morrisville; C. A. Watson of Woodbury; and Alfred Watson of Hartford, Vt.

The first meeting of the corporation was held at Hardwick on March 16, 1895, to elect directors and authorize construction of the road. The proposed road was to connect with the St. J. & L. C. R. R. (then under control of the Boston & Maine) and to extend to the several quarries in Woodbury. Representatives of the St. J. & L. C. and the B. & M. were invited to the meeting in an advisory capacity for the road would be a feeder to their line and the problems of construction "right up the mountain" required expert advice.

The following officers and directors were elected at the meeting:

| | |
|---|---|
| *President* | George M. Powers |
| *Vice-President* | C. A. Watson |
| *Gen'l. Manager* | E. H. Blossom |
| *Treasurer* | J. H. McLeod |
| *Clerk* | Charles L. Sanford |

*Directors*

| | |
|---|---|
| E. H. Blossom (Asst. Supt. St. J. & L. C.) | St. Johnsbury |
| George M. Powers | Morrisville |
| E. R. Fletcher | St. Albans |
| J. V. Dutton | Hardwick |
| W. H. Fullerton | Manchester |
| A. B. Thomas | Hardwick |
| C. A. Watson | Woodbury |

The act of incorporation allowed the towns of Hardwick and Woodbury to purchase the securities of the railroad company and on July 6, 1895 the town of Hardwick voted to buy 400 shares of the capital stock at a par value of $25 per share. The large granite companies and their

officials as individuals as well as many townspeople also bought shares. The town meeting at Woodbury, however, voted against any town aid for the enterprise. Much of the land damage was paid for in stock of the company.

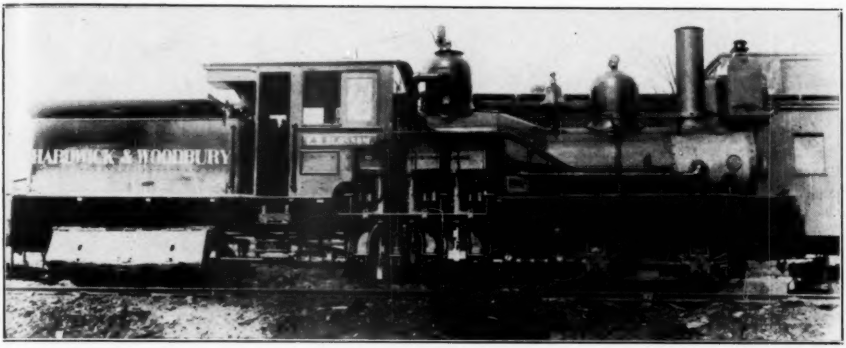
From the start, Mr. E. H. Blossom and Mr. George W. Cree were very active in the affairs of the road. Chief Engineer Williams of the Boston & Maine R. R. assisted in the location of the road. Mr. John S. Holden, an official of one of the granite companies, was a large stockholder and was very influential in floating the stock. He later became president of the road and his name was given to the road's second locomotive.

Several stone sheds were already in operation in Hardwick, and to connect these with the main line, the St. J. & L. C. had built approximately $1\frac{1}{2}$ miles of spur track from Granite Junction, a mile west of Hardwick station. The new line was to continue on up the mountain to the quarries at Woodbury. Construction was authorized to begin at once, but as local labor was to be used as much as possible, the actual work of grading was delayed until the local haying season was over. Wages for ordinary labor were about $1.25 a day. Work was stopped as soon as the ground froze and the first rails were not laid until the Spring of 1896.

The St. Johnsbury & Lake Champlain R. R. furnished rails, spikes and ties, using 56-lb. rail. A locomotive (#250, a 4-4-0 Hinkley) and some flat cars were rented from the Boston & Maine. At first there was no formal contract let for the construction of the road. Later, Messrs. Varnum and Gilfillan were hired to fill some trestles and to do some special work. Several gangs of Italians were obtained from Boston for day labor. At that time there were not very many citizens of Italian extraction in the surrounding country so when these gangs arrived, and with them a plentiful supply of beer and wine, the local citizenry were frightened at what might happen. Nothing did happen, however, for the Italians knew how to use beer and wine and the work went on smoothly without incident. Some of them stayed and became honored and influential members of the community.

From the start, employees of the Hardwick and Woodbury were required to perform many duties not in line with their position on the payroll. All they had to work with was the simplest of tools and their hands. A home-make wooden derrick and rail leader was built on a flat car borrowed from the Boston & Maine. Fortunately there were no expensive bridges to build and maintain, only a small bridge over a brook near Hardwick and a few culverts. There were a few small trestles which were later filled by using waste material from the quarries. Much of the road was cut out of the sidehills and grading was done with wheelbarrows. At the Hardwick-Woodbury town line was a long trestle which later required 6600 cars of material to fill. Timbers for the trestles were cut right on the spot.

By January 1896 five miles had been graded to a point called Foster's Summit. At this point construction had to stop—the little B. & M. 250 could go no further. After a year's delay a Shay engine was




—Courtesy of J. S. Kendall.

H. & W. #1 "E. H. Blossom."


—Courtesy of H. S. Walker.

Hardwick & Woodbury R. R. No. 3.

bought from the Barre Railroad, arriving about August, 1897. This was the engine exhibited at the 1893 Chicago World's Fair by the Lima Locomotive Works. One of the Montpelier & Wells River R. R. (which controlled the Barre road) officials had seen it at the Fair and bought it for use between Montpelier and Barre, and for the Barre Hill work.

A Shay is necessarily slow and its use at top speed by the Barre people had abused it. Nevertheless it was bought by the Hardwick and Woodbury and renamed "E. H. Blossom #1" in honor of the general manager. Its first engineer was A. M. Stone and the fireman Sam Norris. After serving some years, it was supplanted by two larger Shay engines. The "E. H. Blossom" was later used in building the electric road between Concord and Manchester, N. H., and after that was sold to some Southern company.

At the annual meeting held in the Spring of 1897 the following officers were elected.

| | |
|---|---|
| *President* | John S. Holden |
| *Vice-President* | George M. Powers |
| *Treasurer* | George H. Bickford |
| *Secretary* | D. F. Holden |
| *Gen'l. Manager* | E. H. Blossom |
| *Superintendent* | W. H. Fullerton |
| *Gen'l. Passenger and Freight Agent* | J. V. Dutton |

The road was completed to the Woodbury Granite Company quarry about October 1, 1897. It had sixteen miles of track, only nine of which could be called main line. The end of the line was the highest point reached by any railroad in the State. The grades were 9 degree maximum, more than a thousand feet in nine miles, and the curves were 21 degree maximum. The heaviest grade was 7% and the last two miles averaged 5%. There were two switchbacks, one at Foster's Summit and the other at the Thomas quarry. There was a sidetrack at Burnham Hill which was used when it was necessary to "double the hill." The number of cars taken up the hill was limited by the length of the switchbacks.

In some places the railroad had no deeded right-of-way, at others it varied from 16½ feet up. At Foster's Summit the original deed read, "all land necessary for track purposes." At first there was no way to turn an engine or a car on the entire line, so it was decided to put in a wye at Foster's Summit. Abutting land owners put in a claim for compensation but were surprised to find that the original deed entitled the road to take all necessary land without cost.

There were thirteen listed "stations" but not a single company building from one end of the line to the other. Passengers as well as all kinds of freight were carried. Tariffs were on file for various commodities. Shipments were left at any designated point, usually some quarry or the boardinghouse at Woodbury.

It was not expected that the road could operate the year round. On the front page of the local freight tariff always appeared "All rates issued by this road are subject to the right to suspend operations upon

statutory notice on any part or all of its lines during the months of December, January, February and March as provided in its charter." However, until it finally shut down, the road operated regularly summer and winter, except for two months due to a strike of granite workers at the quarries.

The biennial report of the Vermont Railroad Commissioners, dated June 30, 1898 gives the construction cost as $50,691.69 which is remarkable considering the curves, cuts, fills and the rough nature of the country through which the road was built. It is a tribute to the rugged determination and Yankee thrift of the local management.

The earnings of the company fluctuated widely with the demand for granite but at least one year returns were large enough to justify a 12% dividend on the preferred stock and 6% on the common. This dwindled down to less than nothing when operations were finally discontinued, with the road owing the St. Johnsbury & Lake Champlain a substantial sum. The busiest years were from 1906 to 1916. During that time two train crews were frequently required, one being used in switching at Granite Junction and the other at Woodbury. At the peak of operations, the road had about 30 employees.

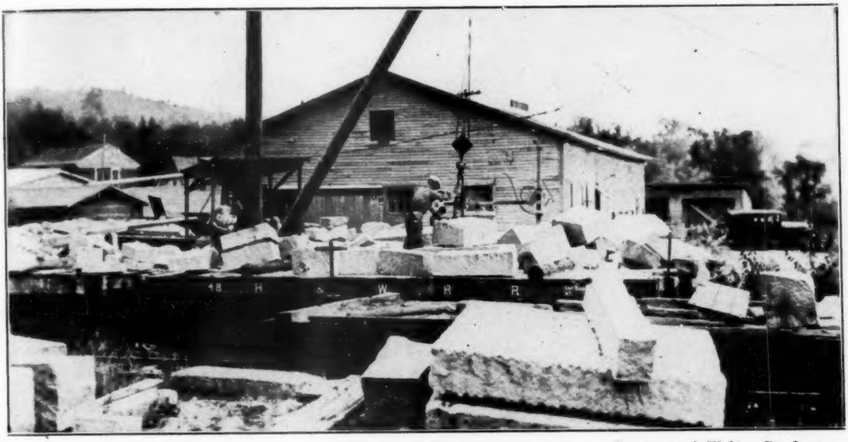
In 1901 a second Shay locomotive was received from the Lima Locomotive Works and was named the "John S. Holden." In 1906 another similar locomotive was purchased. This locomotive was first named "Charles W. Leonard," later "George H. Bickford" and finally, the "Charles A. Hubbard."

It is a mooted question just what road developed the so-called well car for carrying stone, plate glass, etc., but the "Railroad Gazette" in 1899 tells this:

> "A special stone car, designed by E. H. Blossom, general manager of the Hardwick & Woodbury R. R., was built by the Laconia Car Co. for shipping granite blocks 13x17 feet by 18 inches weighing 20 tons net. It consists of a 36-foot platform car with a 20x4 foot cradle in the center. On each side of the opening are three long timbers one above the other, 12 foot square. Running through the timbers are twelve vertical rods (six on each side) 1½ diameter extending down to within eight inches of the top of the rails. Supported by these rods are six transverse oak pieces 4x6 inches trussed with iron rods to form the floor for the load. The upper part of the granite block is braced on each side by seven timbers, the lower ends of which are fastened to the outer edge of the floor."

The Barre & Chelsea R. R. contested the Hardwick road's claim to being the first to have a car of this type. Anyway, the Barre road got the car when the Hardwick road was dismantled. The first shipment on this car was for a mausoleum in Chicago. It was quite an inovation and was extensively copied with some modifications by many other roads.

The flat cars used on the Hardwick & Woodbury were purchased second-hand from other roads, some of them from the Delaware, Lackawanna & Western. They were mostly small wooden ones of light ca-



—Courtesy of Walter D. Jones.

The H. & W. at Hardwick.


—Courtesy of Walter D. Jones.

Snowplow on H. & W R. R.

pacity. Most of them were used only on the line while Boston & Maine cars were used for off system shipments. At first a small 4-wheel B. & M. caboose (#4928) was used. Later B. & A. 1108 (ex-N. Y. C. 3855) was purchased and the 4928 returned to the B. & M.

Winter operations were costly and required every employee's best efforts. There was very meagre equipment and a lot of hand shovelling. During the winter it was not unusual to have to hire forty men to shovel snow. There was no plow to start with but Engineer Stone and his helpers made a small plow without wings that bolted on in front of the engine. When they got up to the first switchback the plow had to be unbolted and put on the other end of the engine. Then at the next one the process was reversed. This plow cleared 4 inches above the rail. The track was so crooked that this was necessary.

Engineer Stone's plow got them through until about 1900. Then a sort of plow, also without wings, was bought from a lumber company. This was put on a flat car and a long lever installed. It took five or six men to lift it at crossings. This plow got them through another winter. In the meantime the St. Johnsbury road acquired a new plow and their old one was bought by the Hardwick & Woodbury. This plow was used until the road was torn up.

Before the wye was put in at Foster's Summit the crew would plow out to the switchback, then go back to Hardwick and 14 miles up the St. Johnsbury & Lake Champlain main line to Morrisville where there was a turntable on which they could turn their plow before they could finish opening up their line. No eight-hour day then. For light snow a flanger was designed by Conductor Hines and built at Lyndonville which worked very well. It was built on a single long truck and later equipped with wings.

During the more prosperous years passenger excursions were run to Woodbury. Two coaches were borrowed from the St. Johnsbury & Lake Champlain and three of the road's own flat cars were equipped with benches. The usual 26-cent one-way fare was cut to 25 cents for the round trip. As many as 450 passengers were carried in a day which included three trips. These excursions terminated with a dance at a storehouse of one of the granite companies. The train crew would wait patiently for the end of the festivities and wind up their day at two or three in the morning of the following day.

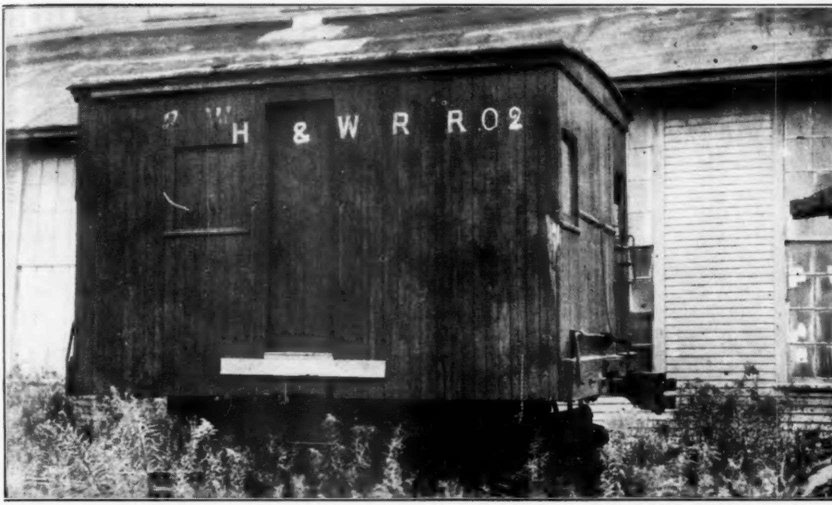
As the result of several mix-ups in schedules, a timetable was devised but it was never printed. Employees copied it and no collision ever occurred on the road. The only accident of note happened one Sunday. Mr. Hubbard, the engineer, had put in a good part of the day working on his engine. Less than half an hour after he left the Hardwick enginehouse three cars of grout came down the hill from some siding and the switch to the enginehouse being open the cars smashed into the No. 2. The engine was pushed through the rear of the house and completely wrecked. It was shipped back to the Lima Works on a flat car where it was rebuilt and returned to service.

In 1925 the Hardwick and Woodbury was taken over and operated by the St. Johnsbury & Lake Champlain until its abandonment in 1934.

Only about 11 miles were operated. Equipment consisted of Engines No. 2 and 3, together with 47 freight cars, few of which were serviceable enough to be allowed off their own line. Little by little employees were dropped and the number of weekly trips was cut from six to four, then three, and finally only when called out. Crews were cut to one conductor, one brakeman, an engineer and a fireman. At the end it was a three-man road with Manager Bailey, Engineer Hubbard and Fireman Carroll Hines as a full crew.

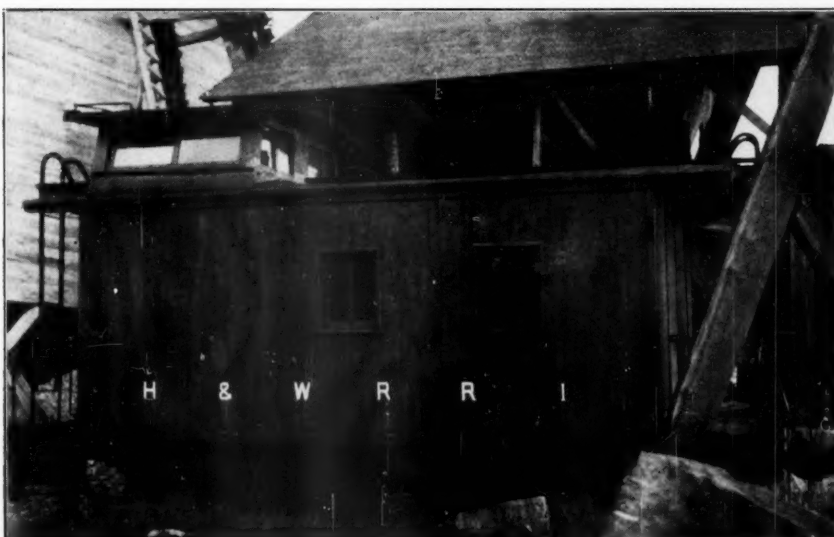
In October 1934 the Interstate Commerce Commission granted the road's petition to abandon the line from the cutting sheds in Hardwick to the quarries in Woodbury. When operations were suspended, Engine No. 3 was in excellent condition and No. 2 was laid up for repairs. With the exception of one flat car taken over by the St. Johnsbury & Lake Champlain, all other equipment was so old and weatherbeaten that it was fit only for scrap.

Mr. James Cannon of the St. Johnsbury and Lake Champlain tried to have the large granite concerns that owned much of the quarry property in the vicinity operate the road but his efforts were without success. The road laid idle from 1934 until August 1940 when the rails were finally taken up.



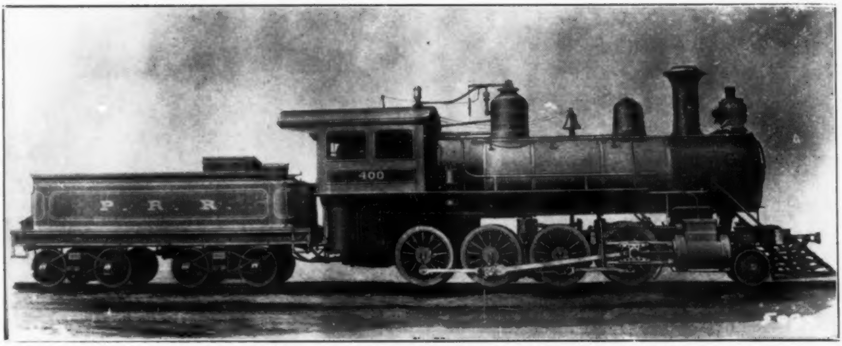

—Courtesy of Walter D. Jones.

4-Wheel Flanger. H. & W. R. R.

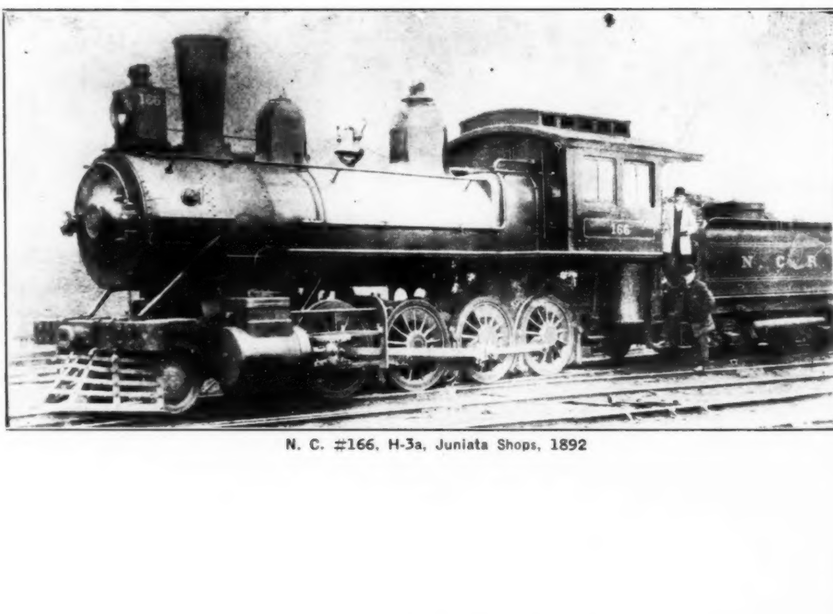



—Courtesy of Walter D. Jones

The Little Old Caboose on the H. & W. R. R.



P. R. R #400, first "R" engine, later class H-3, Altoona, 1885.



N. C. #166, H-3a, Juniata Shops, 1892

# The Class "R" Locomotives on The Pennsylvania R. R.

By Charles B. Chaney

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During the period of the later 1880's and down to the turn of the century, the most as well as the best of the passenger traffic on the Pennsylvania R. R. was handled by their class "O" and "P" locomotives. The former were discussed in Bulletin No. 64, the latter in Bulletin No. 59 of this Society. During this same period, the freight traffic was handled by the class "R" locomotives. Since these have not been presented and there have been several requests for same, this paper will attempt to cover this group of locomotives and, as previously, they will be identified by the Standard Classification of 1897.

In 1885, the Pennsylvania R. R. had hundreds of the old class "I" (new class H-1) consolidation type of locomotive in service. These were first built in 1875, were very efficient haulers but their trailing loads were getting beyond their capacity. It became necessary to design a more powerful locomotive. The Mechanical Department proceeded to design a locomotive of more weight and power but followed the lines of the old class "I." This new design retained the 20x24" cylinders and 50" drivers of the former, but the wheel base was slightly changed—driving wheel base being increased 2" and the total wheel base increased 3". The most noticeable change was the adoption of the Belpaire boiler carrying 140 lb. steam pressure. It might be added here that this Belpaire boiler marked the start of this type of boiler on the Pennsylvania R. R. It has remained standard, down to the present time, including the new multi-cylindered locomotives, though there have been a few instances where the round top boiler was used.

The original class "R" locomotive was No. 400, Altoona Shop No. 983, delivered in October, 1885. This engine was subject to many tests before any more were constructed and it proved to be a powerful and efficient locomotive. As built, it was fitted with the standard 20" inside diameter straight stack with a cap—the same stack, tho' shorter was used on the class "I" engines when fitted with extension front ends and replaced the huge diamond stacks. In the course of the trials of No. 400, a new stack was developed which was the first "bootleg" stack on the road. This stack had a minimum diameter near the base of 18" tapering out to a diameter of 26⅞" at the top, height of stack 4' 10½" above the smokebox.

## Class H-3

The original locomotive, the No. 400 and those that were constructed during the next few years from the same drawings came under this classification. The principal dimensions of this class were as follows: 20x24" cylinders, 50" drivers, Belpaire boiler 59" diameter with steam pressure of 140 lbs., firebox (which was set on top of the frames)

107x42″, 183 tubes $2\frac{1}{2}$″ O. D.—13′ 1 13/16″ long; grate surface 31.1 sq. ft., heating surface—firebox 168.8 sq. ft., tubes 1564.3 sq. ft., total 1731.1 sq. ft. Wheel base—driving 13′ 10″; total engine 21′9″; engine and tender 48′9″. Weights—on drivers 100,600 lbs., total engine 114,625 lbs. The steam dome was 30″ diameter 32″ high. The illustration shows the engine as originally built.

## Class H-3a

In 1891 an improved design of the class "R" appeared. Although the Motive Power records indicate that this design (later known as class H-3a) embraced the "R" engines "built after December 1889" it seems quite certain that the first class H-3a locomotive was the No. 692, which was the first locomotive built at the then new Juniata Shops, delivered in July, 1891. In this H-3a engine, the machine was built somewhat stronger than the H-3. The only major dimensional changes were in the use of a 60″ boiler; firebox 108x42″; 174—$2\frac{1}{4}$″ tubes, 13′3″ long resulting in the total heating surface of 1498.3 sq. ft. The weights were 113,800 lbs. on drivers and 124,800 total engine. A typical H-3a locomotive is shown in Northern Central #166, built at Juniata Shops in January, 1892, their 45th locomotive.

## Class H-3b

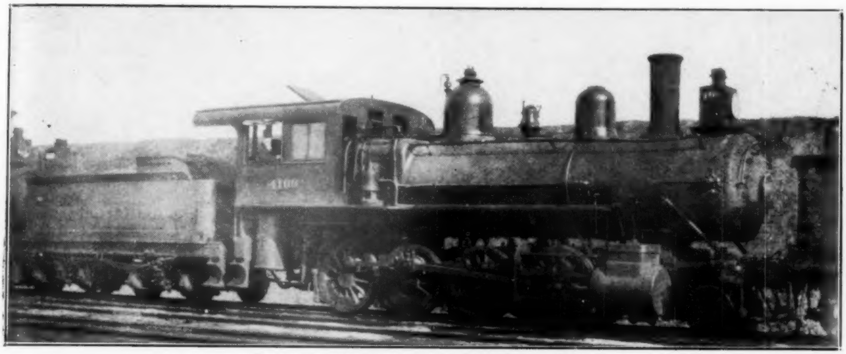
In 1893 the class "R" locomotives were again modified and the first of this group, later classified as H-3b was P. R. R. No. 1623 built at Juniata Shops under their No. 198 and delivered in Feb. 1893. The boiler diameter was again increased to $60\frac{7}{8}$″, all other dimensions remaining the same although the weights were increased slightly—weight on drivers 112,610 lbs. and a total weight of 128,740 lbs. A typical H-3b engine is shown in the No. 4188, Juniata Shops No. 292, delivered Jan. 1894.

## Class H-3c

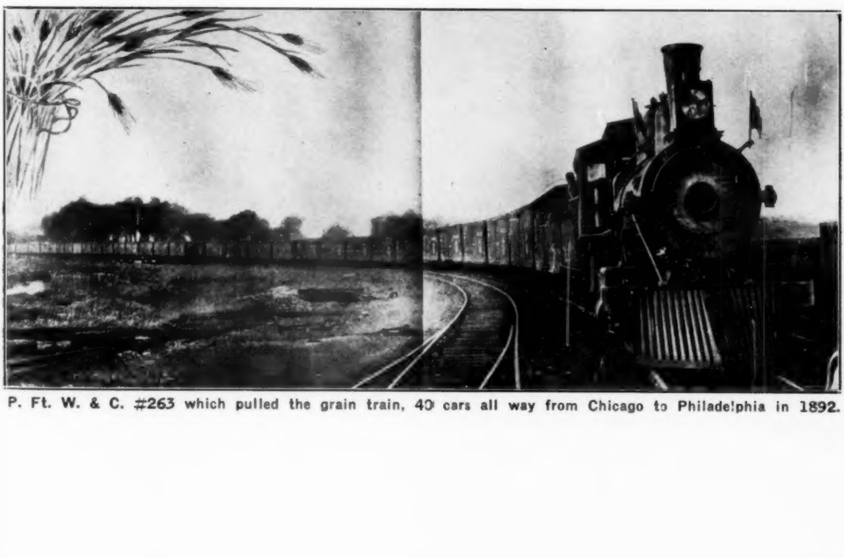
This was a class developed by the Fort Wayne Shops of the Pittsburgh, Ft. Wayne & Chicago Ry. and other western lines. It was not used east of Pittsburgh. The H-3c engine was the same as the H-3a with the exception of the cylinders which were 20x28″. Some of these engines were built new to this class and some were altered from H-3a to H-3c.

## Class H-3e

It will be recalled that the old class "I" (H-1) had what was known as the Altoona boiler. These engines were wonderfully efficient for their day and this boiler was a wonderful steamer; the crown sheet and the outside sheet over the firebox dropped a few inches below the top of the boiler barrel, then sloped downward to the rear. In the later years of their service, some of the H-3 locomotives had their Belpaire fireboxes modified—the crown and top sheets were modified into sloping downward to the rear, similar to the old Altoona boiler and such engines were classified as H-3e.



P. R. R. #4188, H-3b, Juniata Shops, 1894.



P. Ft. W. & C. #263 which pulled the grain train, 40 cars all way from Chicago to Philadelphia in 1892.

## Conversion Into Switching Engines

In the later years of their activity, many of the class "R" engines were converted into switching engines by the removal of the front truck and the rear pair of drivers, thus making them six wheel switchers similar to classes B-4 and B-4a. However, the H-3 engines so rebuilt were reclassified as B-7; the H-3a became B-7a and the H-3b became B-7b. These switchers gave good service but with their short rigid wheel base of 9′3″, they were unsteady and "nosed" quite a bit when at any considerable speed.

In 1891, when the compound locomotive was undergoing trials on many of our railroads, the Baldwin Works built five H-3a locomotives, P. R. R. Nos. 1486-1490 with the Vauclain system of compounding. After several years of service they were rebuilt as simple locomotives. It may be of interest to note that in 1888 the Baldwin Works built for the Virginia Central, their #12 which was based on the H-3 drawings. Later this engine became Western Maryland No. 269.

On the Tyrone & Clearfield and Bedford Divisions, owing to the wooded sections and danger from fire, some of the H-3 and H-3a engines were equipped with an especially designed diamond stack the greatest diameter of which was 54″.

At this late date, owing to the changes in the classification adopted in 1897 and the changes from one sub class to another, it is almost impossible to give the exact numbers of the different classes built. It would appear that upwards of 870 of these locomotives were constructed by Altoona, Juniata, Baldwin and Ft. Wayne. Of this total, probably 430 were H-3; 278 were H-3a; 139 were H-3b and at least 20 were H-3c. In 1939, the Pennsylvania R. R. restored one of these locomotives to her original condition and placed it on exhibition at the N. Y. World's Fair. This was Altoona's shop No. 1235, road No. 1187, built in 1888 and this locomotive is believed to be stored.

For the benefit of the locomotive historian and the "fan," it might be well to define some of the unimportant characteristics of the several sub-classes of these "H" engines, should he come across a photograph of any of them taken, say, prior to 1897 or thereabouts.

All the H-3 locomotives, when built, had the "boot leg" stack, see N. C. #166; all had the cam type driver brakes with cylinder and brake shoes between the second and third drivers; iron pilots 64″ long; the top horizontal and front vertical corners of the Belpaire firebox were rounded with a large radius and the hand rail was continuous from the cab, dropping down several inches at the front of the Belpaire firebox and thence continuing straight to the front of the smoke box. Their cabs had no back board and had a well rounded roof. Except for the stack shown therein, the No. 400 is a correct representative of them all.

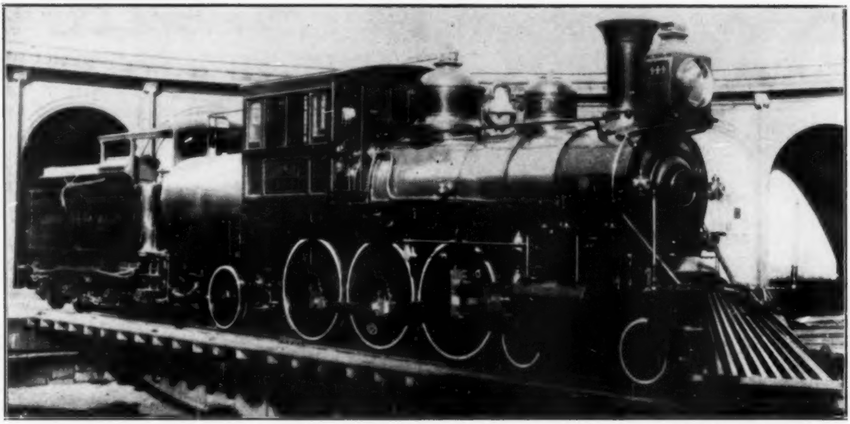
All H-3a engines were built like N. C. #166, with a "boot leg" stack, cab with back board, monitor or "clear story" roof and a driver brake system that included brake shoes acting on the back side of each driving wheel with vertical cylinders behind the rear driving wheel together with an iron pilot only 39″ long.

All H-3b engines, see No. 4188 were built with a cast steel straight stack (not a "boot leg"), hand rails like the H-3a—in two sections, one extending from the cab the length of the firebox, the other section extending the length of the boiler barrel. The cab used was developed for the class D-14a passenger engines, having a rather flat rounded roof, trap door ventilator and back board. The driver brake system was the same as the H-3a and they also had a 39″ pilot.

There were no special "ear marks" whereby the H-3c and H-3e engines could be identified other than the 28″ stroke of the H-3c and the sloping top sheet over the firebox which could be observed on the H-3e.

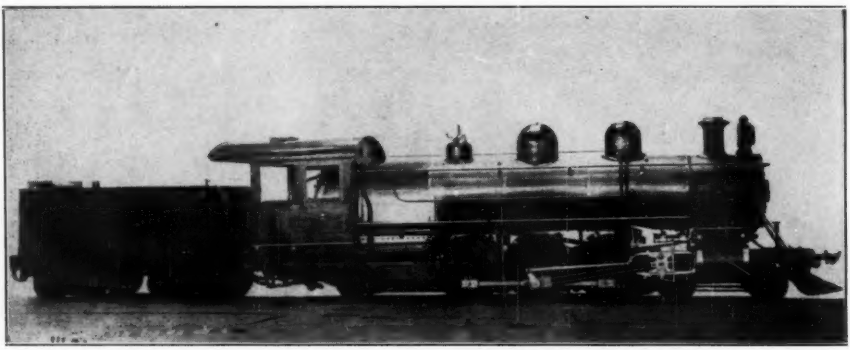
In the later years of their life, many of the H-3 and H-3a had the "ear marks" of the H-3b locomotives replace their original fittings. Also, it will be noted that on P. F. W. & C. #263, that some of the class "R" locomotives had a wooden pilot with vertical slats. However, it is believed that none of the H-3 engines ever lost their much rounded Belpaire corners nor their long continuous hand rail.

This account might well close with a remarkable run made by one of these class "R" locomotives in 1892. The locomotive involved was P. Ft. W. & C. No. 263, built that year in the Fort Wayne Shops. This locomotive may have originally been classified as H-3a but in later years was classified as H-3c. Engine No. 263, coupled to a train of forty (40) standard cars loaded with grain, together with her caboose, left Chicago at 10.00 A. M., April 30, 1892 and pulled this train through to Philadelphia, without being once detached, arriving at the Girard Point elevator in that city at 4.22 P. M. on May 4th, having made the run of 824 miles in four days, 6½ hours. Weight of train was 4,030,500 lbs. A helper engine was used from Pittsburgh to Derry—46 miles; over the mountains from Conemaugh to Gallitzin—25 miles; Columbia to 42nd St., Philadelphia and over the Arsenal bridge. The locomotive and train is shown herewith.



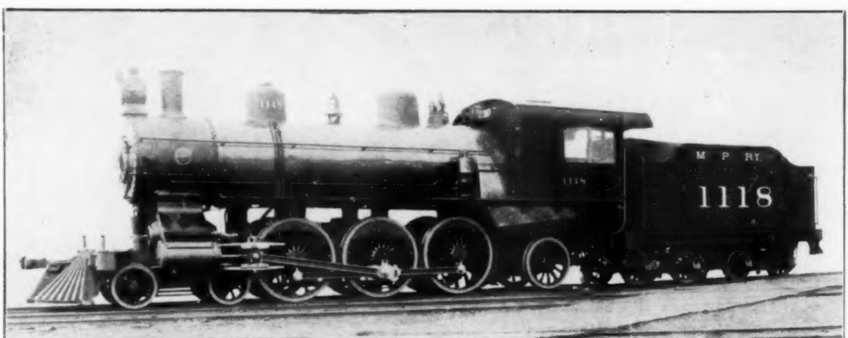
—Courtesy of Clinton T. Andrews.

The First Real Pacific Type—Wilkes-Barre Shops, Lehigh Valley R. R., 1886.
Geo. S. Strong's Patent Boiler and Cylinders.



—Courtesy of Baldwin Locomotive Works.

One of the Pacific Types Built by Baldwin for the New Zealand Gov't. Ry., 1931. Gauge 3ft. 6in.




—Courtesy of American Locomotive Company.

Missouri Pacific Ry. #1118—A. L. Co., 1902.

# Pacific Type Locomotives

By Paul T. Warner

While it is doubtless a fact that the Pacific type is used today in passenger service, at least in the United States, to a greater extent than any other, it is also probably true that it has passed the high point in its development, and that very few Pacific type locomotives will be built in the future. This is largely due to the limitation, in horsepower output, imposed by the use of three pairs of drivers and a two-wheeled trailing truck; and also to the probable future use, to an increasing extent, of electric, Diesel, and possibly gas-turbine locomotives. The great majority of the Pacific type locomotives now in service were built when traffic requirements were by no means as severe as they are today; and it is remarkable how well many of these comparatively old locomotives are meeting present-day conditions. It would seem that, all things considered, this is a favorable time to review the history of the type; how it originated and developed, and what it has accomplished.

What is a Pacific type locomotive? It has the 4-6-2 wheel arrangement, but it is more than merely that. More than 50 years ago, for example, the Chicago, Milwaukee & St. Paul Railway had in service at least three 4-6-2 type locomotives—one built by Schenectady and two by Rhode Island—which were Ten-wheelers with a pair of trailers added in order to keep the weight on drivers within the limit of 90,000 pounds. But these were not Pacific type locomotives; and in the case, at least, of the Schenectady locomotive, the trailers were subsequently removed when track conditions permitted heavier wheel loading, thus changing the locomotive to a 4-6-0.

We would define a Pacific type locomotive as one having the 4-6-2 wheel arrangement, the necessity for applying the rear truck being due to the design of the boiler. Based on this definition, the first Pacific type locomotive was Lehigh Valley engine 444, the *Duplex,* which was built at the Wilkes-Barre, Penna., shops of the Railroad Company in 1886 under the supervision of Alexander Mitchell, Master Mechanic. Mitchell was a veteran in locomotive design and construction; it was he who, in 1866, had prepared the specifications for the locomotive "Consolidation," the first 2-8-0 type with a separate tender. That famous locomotive established one of the most successful types of heavy freight haulers ever built.

The *Duplex* was built in accordance with the designs of George S. Strong, a mechanical engineer who had rather radical ideas on the subject of locomotive construction. A 4-4-0 type locomotive on the Lehigh Valley, Road Number 383, had been running for some time with Strong's patented cylinders, and the results had been encouraging. But in the case of the *Duplex,* Strong also applied a boiler covered by his patents; and this was, in many respects, the most notable feature of the locomotive.

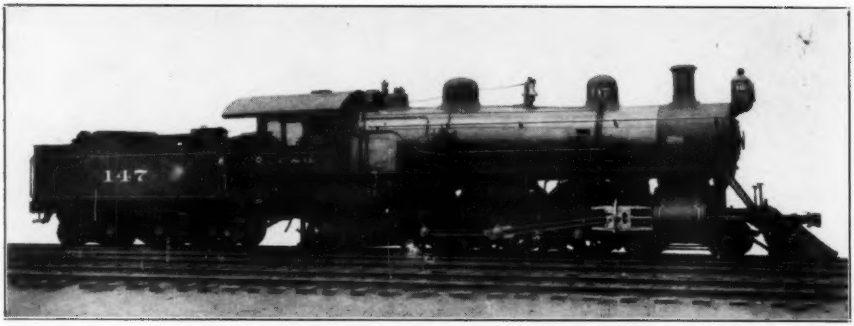
The Strong Boiler had two cylindrical, corrugated furnaces, similar to those used in marine boilers of the Scotch type. These furnaces were placed side by side, in the same horizontal plane, and were connected, at their forward ends, to a common combustion chamber. From this chamber, 306 tubes, $1\frac{3}{4}''$ in diameter and 11 feet 5 inches long, extended forward to the smokebox. The outside diameter of the first boiler ring was 59 inches. The maximum inside diameter of each corrugated furnace was 42 inches, and it was stated that the furnaces were capable of standing an external pressure of 1100 pounds per square inch without collapsing. The overall length of the boiler, including the smokebox, was approximately 33 feet; the grate area was 62 square feet, and the total heating surface 1848 square feet, giving a ratio of approximately 1 to 30. This was suitable for anthracite, which was the fuel used on the Lehigh Valley at that time.

The boiler, which was built at Edgemoor, Delaware, was designed to carry a pressure of 175 pounds per square inch, but in service the safety valves were set at 160 pounds.

The cylinders of the *Duplex* were 20 inches in diameter by 24 inches stroke. Each cylinder had four valves, two for steam admission and two for exhaust. They were slide valves of the grid iron, or multiple-ported type, moving vertically. The steam passages leading to the cylinders were very short, and a small valve movement gave liberal port opening. It was claimed that at short cut-offs, the area of the port opening was much greater than could be obtained with an ordinary slide valve. The valve gear had a single eccentric for each cylinder, and it operated in much the same manner as the so-called "Southern" gear which was used to some extent on American locomotives 25-30 years later.

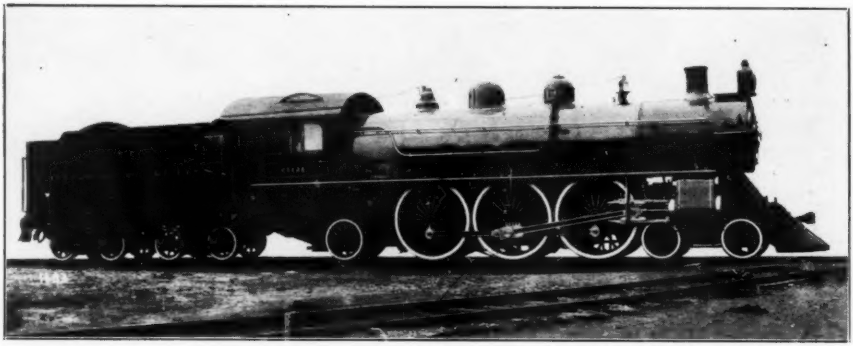
Due to the length and weight of the boiler, a 4-6-0 wheel arrangement would not have been satisfactory; hence a two-wheel rear truck was applied. This truck had a radius bar and was equalized with the drivers. The total wheel-base of the locomotive was 30 feet 4 inches; and the leading drivers had plain tires, so that sharp curves could be easily traversed. The weight in working order was 138,000 pounds, with 90,000 pounds on drivers.

This locomotive, although built by the Lehigh Valley for service on that road, was tested on other lines; and rather extravagant claims were made for its efficiency and capacity. In a test on the Northern Pacific, it was stated that the maximum indicated horsepower was 1810, or one horsepower for each 77 pounds of weight. This is equal to the best that can be expected in present-day practice, using superheated steam and other capacity-increasing devices. That the locomotive represented bold and ingenious designing cannot be denied, but it is significant that the Lehigh Valley acquired no additional locomotives of Strong's design. The "Duplex" was later rebuilt into a 4-6-0 type locomotive with a boiler of the conventional type, and it finally ended its career in a head-on collision on Wilkes-Barre Mountain, on November 11, 1898.




—Courtesy of American Locomotive Company.

**C. & O. Ry. #147, F-15, A. L. Co., 1902.**



—Courtesy of Baldwin Locomotive Works.

**Chicago & Alton R. R. #601, Baldwin, 1903.**


—Courtesy of the Milwaukee Road and Kalmbach Publishing Co.

**C. M. & St P. R. R. #851, Milwaukee Shops, 1905.**

The first locomotives with boilers of conventional design that can correctly be described as "Pacifics," were built by The Baldwin Locomotive Works in July 1901, for the Government Railways of New Zealand. They were specially designed to burn a low-grade coal, or lignite, which clinkered freely and required a large grate area. The railway had in service some 4-6-0 type locomotives previously built by Baldwin which were giving excellent results with higher grade fuel, but which had grates that were too restricted for using lignite. The design of the 4-6-2 type locomotives was based on that of the 4-6-0's, but the boiler was of greatly enlarged capacity, as is shown by the following table which gives the general dimensions and weights of the two types. The gauge of track on the New Zealand Railways is 3 feet 6 inches.

| | 4-6-0 Type | 4-6-2 Type |
|---|---|---|
| Cylinders | 16x20″ | 16x22″ |
| Drivers, diam. | 49″ | 49″ |
| Boiler, diam. | 52″ | 54″ |
| Steam pressure, lb. | 200 | 200 |
| Grate area, sq. ft. | 16 | 40 |
| Total heating surface, sq. ft. | 1321 | 1673 |
| Weight on drivers, lb. | 63580 | 64530 |
| Weight, total engine, lb. | 84040 | 98730 |
| Tractive force, lb. | 17750 | 19600 |

When the specifications for the 4-6-2 type locomotives were prepared, the railway officials particularly requested that, in spite of the unusual width of firebox, the cab be placed at the rear; as they did not wish a "Mother Hubbard" design.[1] The firebox was placed entirely back of the drivers, and the grate had a width of 60 inches. The firebox was radially stayed, and the boiler had a straight top. Piston valves were used, and were operated by Walschaerts gear. The two-wheeled rear truck was of the Rushton type with inside journals, as developed by the builders. It had a swing motion and was fitted with a radius bar, providing a wheel base which was amply flexible for the many sharp curves on the New Zealand lines.

Thirteen of these locomotives were built; three of them were shipped to Auckland in North Island, and ten to Port Lyttelton on South Island. They were used in both passenger and freight service, and apparently met requirements successfully.

In 1902, locomotives of the Pacific type were built by the American Locomotive Company for the Missouri Pacific Railway and the Chesapeake & Ohio Railway, and these were undoubtedly the first Pacifics with boilers of the conventional type, to be built for service in the United States. In both designs piston valves were used, operated by Stephenson valve motion. The rear trucks were of the radial type with inside journals, and were equalized with the drivers.

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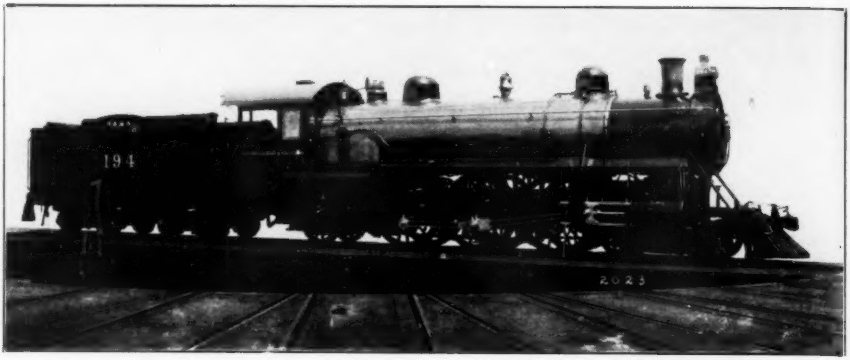
[1] An interesting account of the designing of these locomotives was published in the July, 1924, issue of *Baldwin Locomotives.*

The Chesapeake & Ohio locomotives are of special interest because of their similarity to a number of heavy Ten-wheelers (4-6-0 type) which had been built for the road by the Baldwin Locomotive Works about two years earlier, and which were used in passenger service over heavy grades in the Allegheny Mountains. Both types had 22x28-inch cylinders and driving wheels 72 inches in diameter, and with a steam pressure of 200 pounds, developed a rated tractive force of 32,000 pounds. In each case the boiler was of the extended wagon-top type, with a diameter of 66 inches; but otherwise the boilers were of very different proportions, as the following table shows:

| | 4-6-0 Type | 4-6-2 Type |
|---|---|---|
| Tubes, number and diameter | 360—2″ | 291—2¼″ |
| Tubes, length | 15′0″ | 19′6″ |
| Firebox, length x width | 121⅝x41″ | 90x75″ |
| Grate area, sq. ft. | 34.6 | 47.0 |
| Heating surface, sq. ft. | 3,000 | 3,533 |
| Ratio, grate area to heating surface | 1 to 87 | 1 to 75 |

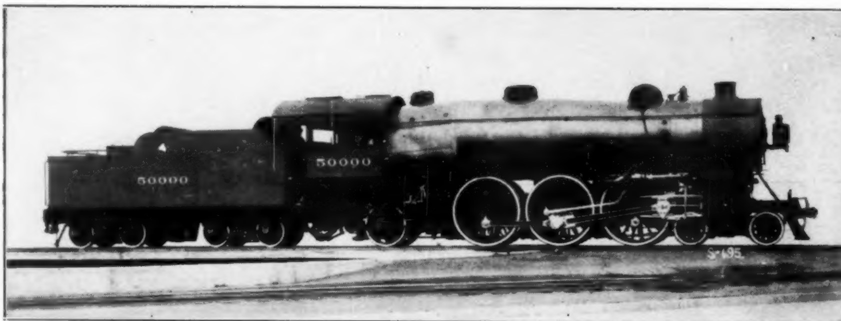
Based on factors used by The Baldwin Locomotive Works, the boiler of the 4-6-0, when working at full capacity, would have evaporated approximately 41,120 pounds of water per hour, and that of the 4-6-2 type, 42,400 pounds. Allowing a steam consumption of 28 pounds per horsepower per hour, the horsepowers developed by the two locomotives would have been 1468 and 1514, respectively. This represents a comparatively small increase for the 4-6-2 type, but if we figure the coal consumption, it becomes evident that the 4-6-0 would be burning fuel at the rate of at least 170 pounds per square foot of grate per hour, while in the 4-6-2 the rate would be only 130 pounds. This assumes that each pound of coal would evaporate 7 pounds of water; but on account of the high firing rate in the 4-6-0, the evaporation would probably have been less, so that the actual fuel rate would have been in excess of 170 pounds. In other words, where the 4-6-2 type, in the hands of an active and skillful fireman, could have developed full power without difficulty, the 4-6-0 would have been forced to the limit and difficult to fire, while wasting an excessive amount of fuel out of the stack. The advantage of the 4-6-2 over the 4-6-0 is therefore considerably greater than would appear from figures giving only water evaporation and probable horsepower.

These first Pacific type locomotives, it should be noted, represented a basic design which has been retained down to the present time. Except in the case of a few locomotives with narrow fireboxes, to which reference will be made shortly, there has been no change in such features as the general design of the boiler, the location of the firebox with reference to the wheels, or the plan of the running gear and spring rigging. Outside valve gear, superheaters, stokers, feed water heaters and other devices have been applied to the type from time to time with a corresponding improvement in efficiency; but the general plan and structure is still the same as that of the Baldwin locomotives which were shipped to New Zealand in 1901.



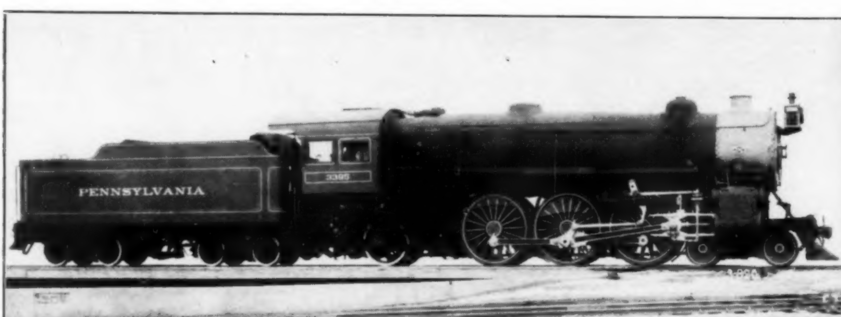
—Courtesy of Baldwin Locomotive Works.

**Associated Lines Standard Pacific except for Compound Cyls. Inside Main Rods Bifurcated. Baldwin, 1905.**



—Courtesy of American Locomotive Company.

**Built for The A. L. Co., Experimental Use. Sold to Erie R. R.**




—Courtesy of American Locomotive Company.

**P. R. R. #3395, K-29s, A. L. Co., 1911.**

The first Pacific type locomotives for domestic service to be built by The Baldwin Locomotive Works, were completed early in 1903 for the Chicago & Alton Railroad. These locomotives were the heaviest yet built for passenger service, and they were purchased in anticipation of increased travel to the World's Fair, which was to be held in St. Louis in 1904. Two locomotives, numbered 600 and 601, respectively, were built; they were practically duplicates, except that engine 600 had driving wheels 73 inches in diameter, while No. 601 had 80-inch drivers. With the smaller wheels, the rated tractive force was 34,870 pounds, and with the larger wheels it was 31,900 pounds; the respective ratios of adhesion being approximately 3.87 and 4.23. In expectation of engine 600 being "slippery," it was equipped with a "traction increaser" operated by compressed air, and under the control of the engineman. When this device was in use, the fulcrums of the equalizing beam connecting the rear driving and trailing truck springs were shifted forward, thus throwing additional weight on the drivers and relieving the trailers of a like amount. This was not a new scheme; it had been applied as far back as 1880 to a single driver locomotive[2] built by Baldwin for the Philadelphia & Reading Railroad, and later other locomotives had been equipped with it, including some heavy Atlantic (4-4-2) types for the New York Central, which were built at Schenectady about two years before the Alton engines were turned out. The value of the device was open to question, as without proper maintenance it was liable to become inoperative.

The Chicago & Alton locomotives had straight-top boilers of large capacity, and piston valves operated by Stephenson link motion. The rear trucks were of the Rushton type with inside journals, and the truck swing was sufficient for traversing 14-degree curves. Further particulars are presented in Table I, which lists the earlier designs of Pacific type locomotives used in the United States.

At the Louisiana Purchase Exposition, held at St. Louis in 1904, three Pacific type locomotives were exhibited; one by the American Locomotive Company and two by The Baldwin Locomotive Works. The first-named was practically a duplicate of the Missouri Pacific locomotives built in 1902, to which previous reference has been made. Of the two Baldwin locomotives, one, built for the St. Louis & San Francisco Railway, was generally similar in weight and dimensions to the Missouri Pacific engine; while the second, built for the Union Pacific, was considerably larger and was, in fact, the heaviest passenger locomotive at the Exposition. It represented one of a series of standard designs which had been prepared for the "Associated Lines," comprising the Union Pacific, Oregon Short Line, Oregon Railway & Navigation Company, Southern Pacific, and Chicago & Alton. The idea was that these roads, controlled by the same financial interests, should use "common standard" locomotives, and the series included a Pacific type for heavy passenger service. There was nothing unusual in the design, which included a straight top boiler carrying 200 pounds pressure, piston valves,

[2] Baldwin Construction Number 5000. This locomotive was later sold to the Eames Vacuum Brake Company, and was sent to England.

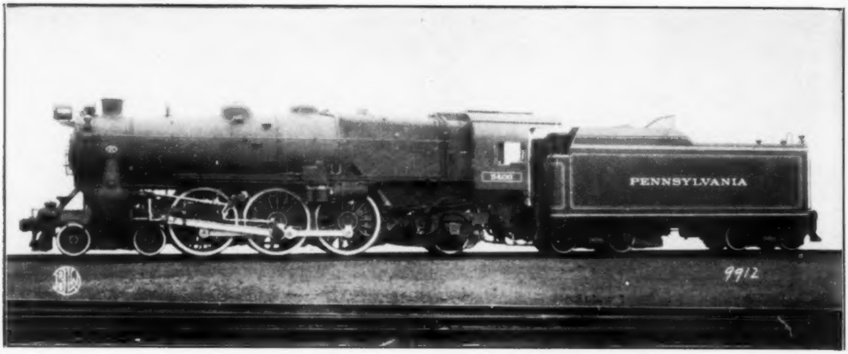
Stephenson valve motion, and driving wheels 77 inches in diameter. The locomotives did good work, and a considerable number—some fitted for burning oil—were built by Baldwin and also by the American Locomotive Company, and were distributed on the various roads included in the combination. Further particulars will be found in Table I.

The Pacific type was now established, and was soon demonstrating its efficiency on various roads throughout the country. It was used not only in heavy express passenger service, but also, to a lesser extent, in fast freight service. For the latter kind of work, some engines were built with driving wheels as small as 63 inches in diameter; while for passenger service, the wheel diameter usually ranged between 68 and 77 inches.

In the year 1905, several interesting designs of Pacific type locomotives appeared. The Chicago, Milwaukee & St. Paul Railway, which had apparently been having trouble with wide fireboxes, built at their Milwaukee Shops, a 4-6-2 type—road number 851—which had a narrow firebox, with a grate 126 inches long and a grate area of 35.8 square feet. The firebox was placed above the trailer frames and back of the rear driving pedestals, but its forward end was between the rear driving wheels. It was specified that the fireman should not have to throw coal a distance exceeding ten feet, and by sloping the back head of the boiler, this requirement was met. The locomotive was reported to steam freely, although the ratio of grate area to heating surface was as 1 to 94.5. This was a big locomotive for its day, weighing 218,000 pounds, with 142,000 pounds on drivers, and developing a tractive force of 32,500 pounds. Piston valves were used, and were operated by Stephenson link motion. The driving wheel centers had the Davis pattern of divided counterweights, and a lateral motion trailing truck was applied, in accordance with designs developed by the Mechanical Department of the Railway.

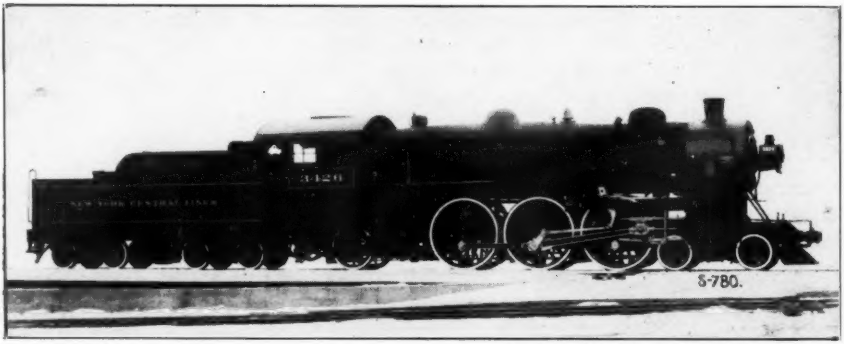
Another notable Pacific type locomotive of 1905 was Erie engine number 2511, built by the American Locomotive Company, and fitted with a Cole firetube superheater. The superheater units were installed in 32 flues 5 inches in diameter, and the superheating surface was 763 square feet. This locomotive was one of the pioneers in the use of high-temperature superheated steam in the United States, and it was also one of the heaviest Pacific types yet built, weighing 230,500 pounds, with 149,000 pounds on drivers. The use of superheated steam was a step in the right direction, although history indicates that the early designs of superheaters were responsible for many headaches in the mechanical and operating departments, as was to be expected.

The year 1905 also saw the first use of balanced compound cylinders on Pacific type locomotives. Such locomotives were built by The Baldwin Locomotive Works for the Oregon Railway & Navigation Company, and the Atchison, Topeka & Santa Fe Railway. The cylinders were placed in line across the engine, with their center lines in the same horizontal plane, the high pressure cylinders being between the frames, and the low pressure outside. All four main rods were connected to the second pair of drivers, and to accomplish this the inside rods were made with a loop or bifurcation, which encircled the first driving axle. As may readily be imagined, such rods were very clumsy, heavy and in-



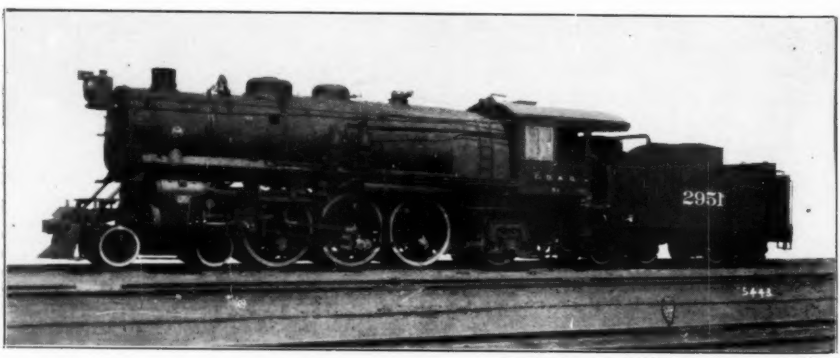

—Courtesy of Baldwin Locomotive Works.

**One of 75 Baldwin Locos., built 1927.**




—Courtesy of American Locomotive Company.

**N Y. C. #3426, K-3a, A. L. Co., 1911.**




—Courtesy of Baldwin Locomotive Works,

**C. B. & Q. R. R. #2951, S-3, Baldwin, 1915.**

accessible, and their maintenance was difficult. A different arrangement of balanced compound was the Cole, as built by the American Locomotive Company, and first applied to the 4-6-2 type in two locomotives built for the Northern Pacific Railway in 1906. In this design, the inside (high-pressure) cylinders were in advance of the low-pressure, and the inside guides were under the cylinder saddle; the main rods taking hold of a crank axle on the first pair of drivers. With this arrangement, the rods were lighter than in the Baldwin design, but the guides were inconveniently located.

Neither of the cylinder arrangements, as described above, was used to any great extent. The Baldwin design was subsequently modified by raising the high-pressure cylinders and placing them on an angle, so that the inside rods could pass above the first driving axle. A total of 115 Pacific type locomotives as so constructed, were built for the Atchison, Topeka & Santa Fe Railway during the years 1911-1914.

The Northern Pacific locomotives, referred to above, had boilers with combustion chambers. This road took a leading part in the development of the combustion chamber boiler, which is now used almost universally in heavy power. Improvements in the art of welding the seams in the firebox and combustion chamber overcame many of the difficulties originally encountered in using this design of boiler.

Apparently the balanced arrangement was the only system of compounding used on Pacific type locomotives. We can find no records of two-cylinder, Vauclain or tandem compounds of the 4-6-2 type.

In 1907 the Pennsylvania System placed in service, on the Lines West of Pittsburgh, an experimental Pacific type locomotive built by the Pittsburgh Works of the American Locomotive Company, which was the heaviest passenger locomotive in existence at that time. This locomotive, designated by the Railroad Company as Class K28, had a radial stay firebox, piston valves, and Walschaerts valve motion. According to the railroad company's records the weight on drivers was 182,100 pounds, or an average of 60,700 pounds per pair. The driving wheel diameter was 80 inches, and the tractive force 32,620 pounds; the ratio of adhesion thus being 5.58. High ratios were characteristic of many of the earlier Pacific type locomotives having drivers exceeding six feet in diameter. Thus, in a group of locomotives with 79-inch wheels, built for the Lake Shore by the American Locomotive Company in 1907, the ratio was 5.84; and in the Pennsylvania's Class K2, designed at Fort Wayne and first built at Altoona in 1910, it was 5.70. These proportions became more favorable with the advent of superheated steam, which, without materially increasing the weight of the boiler, permitted an enlargement of the cylinder dimensions and an increase in starting tractive force, the result being a design that was far better balanced. An early and also a notable example of such a design was locomotive number 50,000, built by the American Locomotive Company in 1911, and subsequently sold to the Erie Railroad.[3] This locomotive, with 79-inch drivers carrying 172,500 pounds, developed a starting tractive force of 40,600 pounds, the ratio of adhesion thus being 4.25.

[3] Road Number 2509.

The design of number 50,000 presented some interesting features. For the first time, cylinders of vanadium cast steel were used, with outside steam pipes which gave the most direct path possible from the superheater header to the steam chests. Vanadium steel was also used for the driving wheel centers, engine frames, connecting rods, crank pins, piston rods, valve motion parts, and springs. Other interesting details were a new design of valve stem guide made integral with the back steam chest head, and the improved Cole-Scoville trailer truck, which omitted the outside supplemental frames formerly used and saved about two tons of weight.

On test, number 50,000 developed a maximum of 2216 horsepower, or one horsepower for 121.4 pounds of locomotive weight, which was considered very satisfactory. The coal rate per indicated horsepower-hour averaged 2.21 pounds, and the steam rate 16.85 pounds. The locomotive was hand-fired.

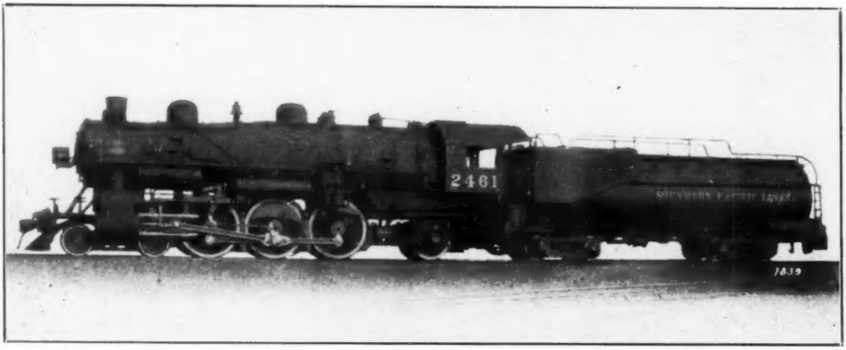
Reverting for a moment to 1908, it should be noted that Baldwin built five large Pacific type locomotives, with narrow fireboxes, for the Chicago & Alton Railway. The arrangement of the boiler with reference to the wheels and frames, was similar to that used on Chicago, Milwaukee & St. Paul locomotive No. 851, which was previously described. In the Alton locomotives, the ratio of grate area to heating surface reached the abnormal value of 1 to 117. It is hardly necessary to say that the wide firebox reappeared in the next group of Pacific types built for the Alton road.

During the years that the superheater was being introduced on American railroads, it was recommended, by some designers and engineers, that superheated locomotives be worked at a moderate steam pressure; and many such engines were built with comparatively large cylinders, the pressure carried being only 150-160 pounds. Several groups of Pacific type locomotives were so built, among them large engines for the Burlington and the Great Northern; the cylinder diameter being 25 or 26 inches as compared to 22 or 23 inches in locomotives of practically the same weight, but using saturated steam at a pressure of 200 pounds. No material advantage resulted, however, and the locomotives were subsequently modified, the cylinders being bushed down to a smaller diameter and the boiler pressure raised so that the desired tractive force could be maintained. Subsequent to 1910, a pressure of 200 pounds was usually carried on superheated locomotives, and this was considered the accepted practice until about 1925, when pressures began to rise rapidly.

In 1910, the Pennsylvania built a heavy Atlantic (4-4-2) type locomotive, Class E6, which, although not fitted with a superheater, proved a pace setter for future passenger motive power on that road. It was followed by two other locomotives of generally similar design, but using superheated steam; also by an experimental Pacific type locomotive (Class K29, road number 3395) built by the American Locomotive Company. This last-named locomotive, with a total weight of 317,000 pounds, was the largest Pacific type in existence at that time. Based on thorough tests made with these locomotives, as well as with Pacific type loco-

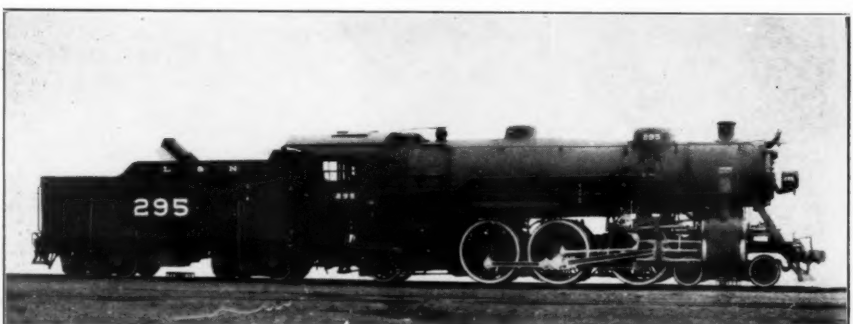

—Courtesy of Baldwin Locomotive Works.

**U. S. R. A. Heavy Pacific Type. Erie R. R. #2926, K-5, Baldwin, 1919.**




—Courtesy of Baldwin Locomotive Works

**Southern Pacific #2461, P.8, Baldwin, 1921.**




—Courtesy of American Locomotive Company.

**Louisville & Nashville R. R., Class K-7, A. L. Co., 1925.**

motives of the Class K2 group, the Pennsylvania, in 1914, built a new Pacific type designated Class K4s. One locomotive, road number 1737, was turned out and was put through a series of most exacting tests on the road and also on the Altoona Plant, which fully demonstrated the soundness of the design. As a result, 424 similar locomotives followed during the years 1916-1928, constituting one of the most successful motive power groups ever used on any railroad.

Class K4s, with 27x28-inch cylinders, driving wheels 80 inches in diameter, and a steam pressure of 205 pounds, developed a rated tractive force of 44,460 pounds. As originally built, the average load per pair of driving wheels was 67,300 pounds, and the ratio of adhesion 4.54. The great majority of these locomotives were hand-fired, with the exception of a group built for the Lines West of Pittsburgh, to which Crawford under-feed stokers were applied. While this device was satisfactory as far as combustion of the fuel was concerned, it was difficult to maintain and was later removed.

In accordance with Pennsylvania standards, Class K4s has a boiler of the Belpaire type, with a combustion chamber and tubes of moderate length. A light design of Walschaerts valve motion is used; originally this was controlled by a screw reverse mechanism, but subsequently power reverse gears were applied. Practically all the locomotives used in heavy main line service are now fitted with stokers of the over-feed type; a change which has materially increased their capacity.

Contemporary with the Pennsylvania locomotives of the K2 and K4 groups, were the Class K3 locomotives of the New York Central, which first appeared in 1911, and which were built by both the American Locomotive Company and The Baldwin Locomotive Works. These locomotives had 79-inch wheels; the cylinders were of moderate size, and with 171,500 pounds on drivers and a tractive force of 30,900 pounds, the ratio of adhesion was 5.55. Subsequently, boosters were applied to at least some of the locomotives of this class, increasing their starting tractive force by 9,700 pounds. Contemporary with these high-wheelers was a group of Pacifics with 69-inch wheels (Class K-11-C) which were designed for fast freight service. Particulars of both classes will be found in Table II.

In 1915, Baldwin built a group of 4-6-2 type locomotives for the Burlington (Class S-3), which, while not exceptionally large, were notable because of the design of their machinery. With a view of reducing the weights of the reciprocating and revolving parts, the piston heads were of rolled steel, the crossheads were of the Laird type and of light design, and heat-treated alloy steel was used for the piston rods, crosshead pins, main and side rods, crank pins and side rod knuckle pins. Walschaerts valve gear was used, controlled by a power reverse mechanism. The tractive force was 42,200 pounds, with a ratio of adhesion of 4. Class S3 did good work; 15 engines were built in 1915, and were followed by ten more in 1918.

In 1916, the New York, New Haven & Hartford Railroad, which had been hauling heavy passenger trains with 4-6-2 type locomotives since 1907, received a group of 50 Pacifics (Class I-4) from the American

Locomotive Company, which did exceptionally fine work on the Shore Line between Boston and New Haven. These locomotives had 79-inch driving wheels and developed a rated tractive force of 40,800 pounds. Many of them were later fitted with syphons, feed-water heaters, and type "E" superheaters, which materially increased their capacity and efficiency. They carried the passenger load on the Shore Line until 1937, when they were partially replaced by new Baldwin 4-6-4 type locomotives, and later by Diesel-electric power.

The series of so-called standard locomotives, which were designed in 1918 for the United States Railroad Administration, when the Government was operating the railroads, included two classes of Pacific type locomotives—one, the light, designed for an average driving axle load of 53,000 pounds, and the other, the heavy, designed for 60,000 pounds, axle load. These locomotives conformed to clearance limits which permitted their operation on practically any trunk line railroad in the United States. The lighter class was built in far greater numbers than the heavier, and was placed in service on roads in various parts of the country.

The two classes of standard Pacifics were closely similar in design. The lighter locomotive had 73-inch drivers and developed a tractive force of 40,750 pounds, while the heavier, with 79-inch drivers, developed a tractive force of 43,900 pounds. Common to both classes were combustion chambers, tubes 19 feet long, Baker valve gear, trailer trucks of the Cole-Scoville pattern, and Commonwealth rear frame cradles, each cast in one piece. The heavier locomotive was stoker-fired, while the tender of the lighter was fitted with a slope-sheet coal pusher. Interchangeable detail parts were used where practicable, many of these details being also interchangeable on other types of standard locomotives.

The U. S. R. A. locomotive exerted a marked influence on subsequent designs built for various roads, and this was particularly true in the case of the light 4-6-2 type. Many such locomotives are still being used in exacting service and are doing excellent work.

In 1921, Baldwin built, for the Southern Pacific Company, 15 Pacific type locomotives of notable design. These engines were placed in service between Ogden, Utah, and Carlin, Nevada, hauling without assistance, trains of as many as 11 cars over grades of 1½ percent in each direction. The driving wheel diameter (73½ inches) was practically the same as that of the U. S. R. A. light Pacifics, and the cylinder diameter and steam pressure were the same; but the stroke was increased from 28 to 30 inches, raising the tractive force to 43,660 pounds. The ratio of adhesion, with 180,000 pounds of drivers, was 4.12. Oil was used for fuel; the firebox had a combustion chamber 36 inches long, and the tube length was 18 feet. The locomotives did fine work under trying service conditions, and were followed by others of similar design, which were placed in operation on various sections of the Southern Pacific Lines.

During the years 1922-1930, a number of prominent roads in the United States became interested in three-cylinder locomotives, which were strongly advocated by the American Locomotive Company. Pacific type locomotives with three cylinders were built in 1924 and 1925,

for the Rock Island, the Louisville & Nashville, and the Missouri Pacific. All were designed by the builders, and were generally similar in dimensions. The Baldwin Locomotive Works built no three-cylinder Pacific type locomotives for domestic roads, and the Lima Locomotive Works took no interest in this multi-cylinder arrangement.

The last large group of Class K4s locomotives for the Pennsylvania appeared in 1927, when The Baldwin Locomotive Works turned out 75, having the road numbers 5400-5474. Contemporary with them were a number built at the Altoona Works of the Railroad Company. Five of the latter group had one-piece cast steel beds with integral cylinders, which were furnished by the General Steel Castings Corporation. The basic dimensions of all these locomotives were the same as that of the original Class K4s built in 1914—a remarkable tribute to the efficiency of the design.

In 1929, the Pennsylvania placed in service two Pacific type locomotives of Class K5, one (road number 5698) built at the Altoona Works, and the other (number 5699) at The Baldwin Locomotive Works. Engine 5698 was fitted with piston valves and Walschaerts gear, while the 5699 had poppet valves operated by Caprotti gear. The boiler shell plates were nickel steel. As compared with Class K4s, the boiler was increased in dimensions—except the grate area, which remained the same—the pressure was raised from 205 to 250 pounds, a type "E" superheater was used instead of a type "A," and a feed-water heater was applied. Another important change was an increase of two inches in the piston stroke. In engine 5698, cut-off in full gear took place at 67 per cent of the stroke, giving a rated tractive force of 54,675 pounds, with a ratio of adhesion of 3.80; while in engine 5699, with Caprotti gear, the maximum cut-off was 80 per cent, with a tractive force of 58,090 pounds, and a ratio of adhesion of only 3.59. Due to frequent failures in service, the Caprotti gear and poppet valves were subsequently replaced by piston valves and Walschaerts gear. Class K5 represented a noteworthy attempt to obtain maximum capacity with the 4-6-2 wheel arrangement, while keeping within specified weight and clearance limitations. Expectations, however, were probably not realized, as indicated by the fact that no additional locomotives of this class have been built.

Reverting now to the year 1927, mention should be made of two other notable groups of Pacific type locomotives built by Baldwin for eastern roads. The Baltimore & Ohio received 20 locomotives of Class P-7, which were placed in through service between Washington and Jersey City, operating over the Reading tracks from Philadelphia to Bound Brook, and thence over the tracks of the New Jersey Central. These locomotives, numbered 5300-5319, inclusive, at once attracted popular attention; largely because they were painted green, and each one was named after a president of the United States. They had the same size cylinders and driving wheels as the Pennsylvania's Class K4s, and the boilers were comparable in dimensions; but the Baltimore & Ohio locomotives carried a steam pressure of 230 pounds, giving them a rated tractive force of 50,000 pounds. One locomotive was experimentally

fitted with a booster on the rear truck, which increased the total tractive force at starting to 61,000 pounds. All were stoker-fired. The piston valves were 14 inches in diameter, and a light design of Walschaerts valve gear was applied and was controlled by a power reverse mechanism.

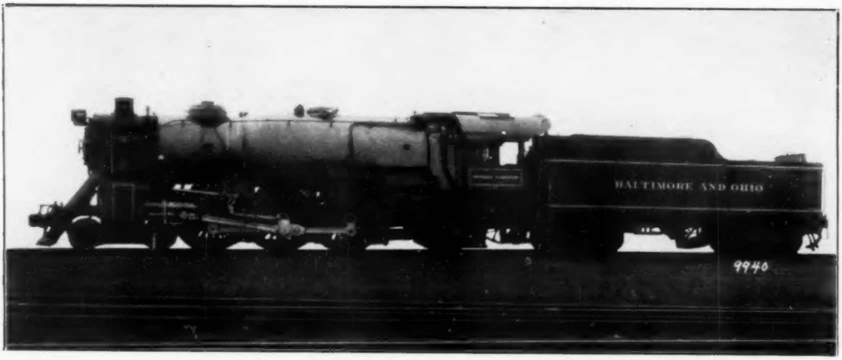
In this connection mention should be made of the locomotive President Cleveland, road number 5320, which followed the Baldwin engines, and was built at the Baltimore & Ohio's Mt. Clare Shops in Baltimore. It was fitted with an Emerson water-tube firebox, and had poppet valves operated by Caprotti valve gear. Some years later it was partially rebuilt with piston valves and Walschaerts gear.

The second group of Baldwin Pacifics built in 1927, to which reference has been made, were specially designed for the Washington—Richmond service of the Richmond, Fredericksburg & Potomac Railroad. They were among the heaviest of the type in service at that time, weighing 332,600 pounds with 205,300 pounds on drivers. The bulk of the freight handled by the R. F. & P. is moved on fast schedules, and the great majority of the road engines, especially of the 4-6-2 and 4-8-4 types, are used interchangeably in either passenger or freight service. The Pacific types built in 1927, with their large boilers, mechanical stokers, 75-inch drivers and a rated tractive force of 48,580 pounds, met the requirements of the service remarkably well.

In the fall of 1930, the American Locomotive Company built, for the Chicago, St. Paul, Minneapolis & Omaha Railway, three 4-6-2 type locomotives which are the heaviest of their type on record, weighing 347,000 pounds with 210,000 pounds on drivers. It is doubtful whether the total weight will ever be exceeded in a 4-6-2 type. The tractive force of 51,300 pounds is correspondingly high, and this can be augmented at starting by a booster to a total of 64,400 pounds. A steam pressure of 260 pounds is carried, and the superheater is a type "E," with 2,017 square feet of surface. With an adhesion ratio of 4.09 the weight on drivers is fully utilized, and the design is noteworthy in view of the capacity obtained in a 4-6-2 type with a 70,000-pound axle load.

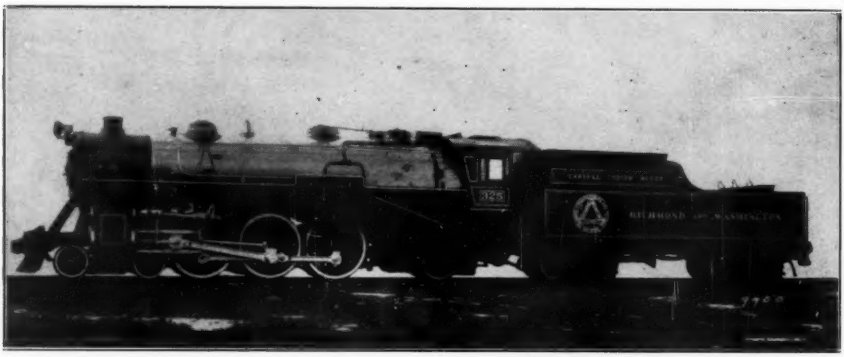
The latest Pacific type locomotives built for service in the United States are ten on the Boston & Maine, built by the Lima Locomotive Works. Five of these, road numbers 3710-3714 (Class P-4-a), were turned out in 1934, and the remaining five, numbers 3715-3719, (Class P-4-b) in 1937. This is a highly-developed design, with 80-inch driving wheels, a working pressure of 260 pounds, and a rated tractive force of 40,900 pounds, which can be augmented, by a booster on the rear truck, to 52,800 pounds. The equipment includes a stoker and a feed-water heater; also three syphons in the firebox. Walschaerts valve gear is applied. The eight-wheeled tenders have capacity for 12,000 gallons of water, and 18 tons of coal. In Class P-4-a, the mountings on the top of the boiler were covered by cowling, giving the locomotives a semi-streamlined appearance. This arrangement was omitted on Class P-4-b. Both classes have smoke lifting plates at the sides of the smokebox. The operating results given by these locomotives have been very satisfactory.

In 1944 the Canadian Pacific built, at its Angus Shops, two very interesting Pacific type locomotives of moderate weight, the average



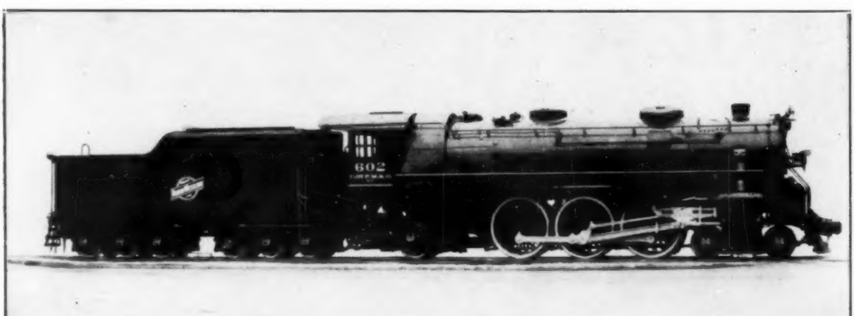

—Courtesy of Baldwin Locomotive Works.

**Baltimore & Ohio R. R. #5300, P-7, Baldwin, 1927.**




—Courtesy of Baldwin Locomotive Works

**Richmond, Fredericksburg & Potomac R. R. #325, Baldwin, 1927.**




—Courtesy of American Locomotive Company.

**Chicago, St. Paul, Minneapolis & Omaha #602, Class E-3. Heaviest 4-6-2 to date. A. L. Co., 1930.**

load per pair of driving wheels being 50,000 pounds. The rated tractive force is 34,000 pounds. These locomotives are to replace old main line power which had been relegated to secondary service, and which now could be profitably scrapped. Additional Pacifics of similar design were subsequently ordered. A notable feature of these engines is the domeless boiler, steam being taken through a perforated dry pipe placed as high above the water level as possible. The entire design has been worked out with characteristic Canadian Pacific thoroughness. The eight-wheel tender carries 8,000 Imperial gallons of water and 14½ tons of coal.

Many fine locomotives of the Pacific type are in service on the Canadian Pacific and the Canadian National Railways. They have not been discussed in this article, but the new medium-weight locomotives for the Canadian Pacific Railway are of such unusual interest that they deserve to be mentioned.

Of the railroads serving the anthracite region of Pennsylvania, the Lehigh Valley, Reading, New Jersey Central, Lackawanna, and the Delaware & Hudson, have all used hard-coal burning Pacific type locomotives. Some of these locomotives are now burning straight soft coal, and some a mixture of anthracite and bituminous; and several of the roads mentioned have 4-6-2 type locomotives originally designed to burn soft coal. A brief review of these various designs will prove of interest.

The Lehigh Valley was the first road to operate anthracite-burning Pacific type locomotives. Three such engines were built by Baldwin in 1905, and were followed by five more, of the same general dimensions, in 1906. At that time the road had in service ten Prairie (2-6-2) type passenger locomotives, and the Pacific types were in many respects similar to them. All had boilers of the modified Wootten type without combustion chambers, and they all had slide valves operated by Stephenson link motion. They were big locomotives for their time, and with the exception of the Strong locomotive Duplex, previously described were the only "Mother Hubbard" 2-6-2 and 4-6-2 types ever built. The former were subsequently changed to the 4-6-2 type in order to improve their tracking qualities.

In 1913 the Lehigh Valley brought out a new Pacific type, which was designed by the Company and built at Sayre Shops. It used superheated steam and was fitted with piston valves and Walschaerts gear, and developed a rated tractive force of 41,600 pounds. As in the first Pacifics, the firebox was of the modified Wootten type without combustion chamber, but the cab was placed at the rear. These locomotives were designed to haul a train weighing 550 tons behind the tender, from Mauch Chunk to Glen Summit, where the maximum grade is 67 feet to the mile. Eastbound up Wilkes-Barre Mountain, where the maximum grade is 95.7 feet, the rating was 360 tons. Eleven of these locomotives were built in 1913 and 1914; they were followed, in 1915-1921, by 30 additional Pacifics having the same size cylinders and drivers and carrying the same steam pressure. Of these, 15, which were placed in service on the western end of the system, had narrower fireboxes suitable for burning bituminous coal.

Contemporary with these Sayre-built locomotives were two groups of Pacific type locomotives for fast freight service, which were built by The Baldwin Locomotive Works. The locomotives comprising the first group, 30 in number, were built in 1916 and were soft-coal burners; 20 of these (road numbers 2100-2119) had Walschaerts valve gear, while the remaining ten (numbers 2120-2129) had Baker gear. The grate area was 75 square feet, and mechanical stokers were applied. The fireboxes had combustion chambers, and the inside firebox seams were welded. Special steels were used for the reciprocating parts, in order to reduce weight. With 73-inch drivers, a rated tractive force of 48,720 pounds, and ample boiler power, these were among the notable locomotives of their day. They were used between Manchester, New York, and Coxton, Pennsylvania, a run of 175 miles, hauling 50-car trains in each direction in 5½ hours, over maximum grades of 0.4%.

The second group of fast freight Pacifics, to which reference has been made, were designed to burn a mixture of anthracite and bituminous coal, and had Wootten fireboxes with a grate area of 95.2 square feet. They were all fitted with Walschaerts gear, and their details interchanged, as far as possible, with those of the soft-coal burners.

The Lehigh Valley's latest Pacific type is Class K-6-B, built by the American Locomotive Company early in 1924. These are passenger locomotives, with 77-inch drivers; they develop a rated tractive force of 41,500 pounds, which may be augmented to approximately 52,000 pounds by means of a booster on the rear truck. They are soft-coal burners, with a grate area of 75.3 square feet, and were fitted with stokers when built. These are fine looking locomotives, with trim lines and a neat arrangement of piping and accessories; and in service they have done all that was expected of them.

Several years ago, the Lehigh Valley streamlined a number of its Pacific type locomotives, assigning them to such trains as the Black Diamond, the John Wilkes and the Asa Packer, which were modernized with streamlined equipment. We cannot say, however, that the changes made in the locomotives have in any sense improved their appearance; and under present conditions, the trains are made up of a variety of rolling stock—streamlined and otherwise.

The Reading Lines first introduced Pacific type locomotives in 1916, for the particular purpose of handling Baltimore & Ohio passenger trains between Philadelphia and Jersey City. It was not the practice, at that time, to run the Baltimore & Ohio locomotives north of Philadelphia, and the trains had become too heavy for the Atlantic type engines used by the Reading and the New Jersey Central. The new Pacifics had driving wheels 80 inches in diameter; they were hand-fired, with Wootten boilers and a grate area of 94.5 square feet, suitable for burning lump anthracite or a mixture of fine anthracite and bituminous coal. Walschaerts valve gear was applied and the machinery was carefully designed, with a view of eliminating superfluous weight. These engines were designated Class G-1-s-a, and during the years 1916-1924, 30 were built—25 at the Reading Shops and five by The Baldwin Locomotive Works. Baldwin also built, in 1925, five locomotives of Class G-1-s-b,

which were like those just described except that they had 74-inch drivers; and these were followed, in 1926, by five of Class G-2-s-a, with 80-inch drivers and somewhat larger boilers, carrying a pressure of 230 pounds, as against 220 pounds in the previous classes. The locomotives of these several classes are now stoker-fired.

The Reading's Pacific type locomotives are now widely distributed over the System. The locomotives with 74-inch wheels are used chiefly on the Main Line, between Philadelphia and the coal regions, and on the Bethlehem Branch. The locomotives with 80-inch wheels handle the bulk of the passenger traffic between Philadelphia and Jersey City, and some are assigned to the Pennsylvania-Reading Seashore Lines, operating between Philadelphia, Camden, and New Jersey coast resorts. In both these services, high running speeds are frequently attained. The high-wheelers are also used on the Main Line and the Bethlehem Branch.

Some years ago, engines 117 and 118, of Class G-1-s-a, were streamlined in stainless steel and blue paint to haul the Crusader, the Reading's crack Philadelphia-New York train; and engines 108 (G-1-s-a) and 178 (G-2-s-a) were partially streamlined with modernized contour, concealed piping, etc. The two latter locomotives especially, present a most attractive appearance.

On the Central Railroad of New Jersey there are four groups of Pacific type locomotives, all of them built by Baldwin. The first group of six locomotives—Class G-1-s, road numbers 820-825, appeared in 1918. These locomotives were intended to work alongside the Reading Pacifics in the Philadelphia-Jersey City joint service, and they were also suitable for service on the Main Line and over the Lehigh and Susquehanna Division to Wilkes-Barre and Scranton. They had cylinders one inch larger than the Reading locomotives, and the boiler—which was of the Wootten type with combustion chamber—was larger, although the grate area was practically the same. The fuel was specified as fine anthracite. With their wide fireboxes, Cole-Scoville trailer trucks, Walschaerts gear and certain other features, they looked not unlike the Reading engines in many respects, although their appearance was more massive. They were followed, in 1923, by five more (numbers 826-830, Class G-2s) which were closely similar in design. These had brick arches supported on water tubes, and were fitted for burning a mixture of anthracite and bituminous coal.

Class G-3s, which was placed in service early in 1928 (numbers 831-835) represented a change, in that it was a soft-coal burner with a firebox one foot narrower than the previous engines, and it was equipped with a stoker and a feed-water heater. The cylinder and driving wheel dimensions were unchanged, but the steam pressure was increased from 210 to 230 pounds, thus raising the tractive force from 42,770 to 46,840 pounds. This, however, was materially exceeded in the next group (Class G-4s) built in 1930, in which the driving wheel diameter was reduced from 79 to 74 inches, while the steam pressure was raised from 230 to 240 pounds, the resulting tractive force being 52,180 pounds. There were five of these locomotives, numbers 810-814, and they were specially designed for service over the heavy grades on the run to Wilkes-Barre and Scranton, and were kept within a height limit of 14 feet 10 inches so that they could operate through the Lansford Tun-

nel between Mauch Chunk and Tamaqua, Pennsylvania. They have the same size grates as Class G-3s, and are stoker-fired and equipped with feed-water heaters.

The several classes of Pacific type locomotives just described, in addition to handling through traffic on the New Jersey Central Lines, are used to some extent in the heavy suburban express service out of Jersey City, where trains of ten to twelve cars must be hauled on exacting schedules. The latest group, with 74-inch wheels, is particularly well fitted for such service.

The Lackawanna has used Pacific type locomotives in both passenger and freight service. All the passenger locomotives, 40 in number, were built by the American Locomotive Company and were designed to burn hard coal. While these locomotives have various features in common, there are marked differences in certain groups. Two sizes of driving wheels are represented, 73 and 79 inches, there being 19 locomotives with the former size wheel and 21 with the latter. All 40 were built during the years 1912-1923; all originally used superheated steam, and all were hand-fired.

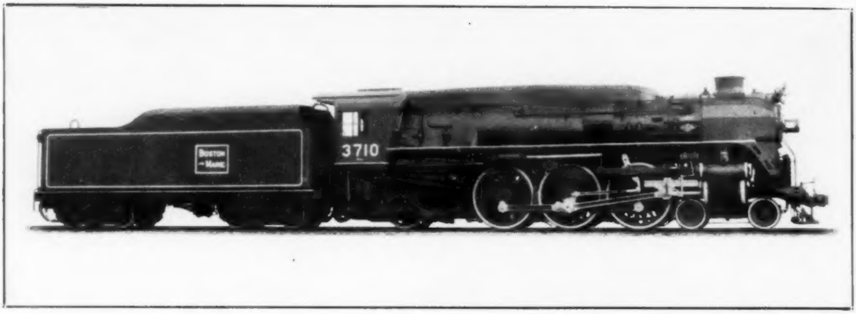
For many years, one of the problems on the Lackawanna has been to reduce helper service over the Pocono Mountains to a minimum; and heavy passenger power has usually been designed with that end in view. This was particularly true of the five Pacific type locomotives, road numbers 1131-1135, built in 1915. Whereas all the other Lackawanna Pacific types have 25x28-inch cylinders, in this group the diameter was increased to 27 inches; and with 73-inch drivers and a steam pressure of 200 pounds, this gave a rated tractive force of 47,500 pounds. They were designed to handle nine cars weighing 600 tons up the 16-mile grade from Stroudsburg to Pocono Summit, at an average speed of 30 miles an hour. This grade reaches a maximum of 78 feet per mile, with curves as sharp as six degrees. The locomotives proved equal to the job.

According to the railroad company's locomotive diagram book, all the locomotives with 79-inch wheels are now carrying 225 pounds of steam, giving them a rated tractive force of 39,500 pounds. The earlier Lackawanna Pacifics had Walschaerts valve gear, but Baker gear was applied to the later engines.

The freight Pacifics were built by the American Locomotive Company and the Lima Locomotive Works, Inc. They had narrower fireboxes than the passenger locomotives, and were designed to burn bituminous coal. The driving wheel diameter was 69 inches and the tractive force 43,100 pounds. Some of these locomotives were later rebuilt into heavy switchers of the 0-8-0 type.

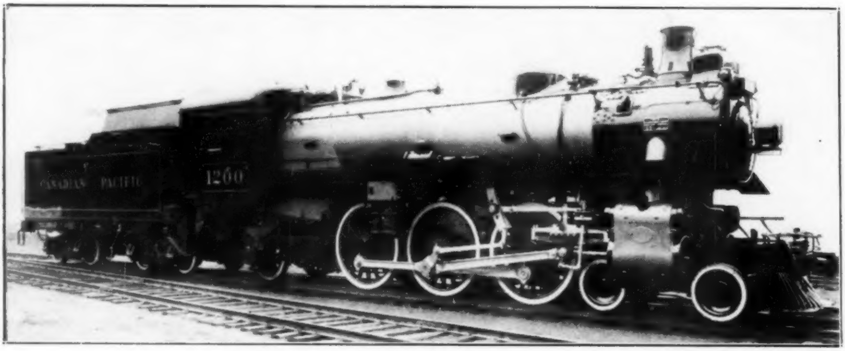
The locomotive diagram book of the Delaware & Hudson Company lists 13 Pacific type locomotives. Ten of these (road numbers 600-609 inclusive) were built by the American Locomotive Company in 1914; while numbers 651, 652 and 653 were built by the Railroad Company in the years 1930, 1929 and 1931 respectively. All have driving wheels 73 inches in diameter, and the boilers are of the modified Wootten type, designed for burning hard coal.[4] Type "A" superheaters are used in

[4] Bituminous coal, or a mixture of anthracite and bituminous, is now used.




—Courtesy of Lima Locomotive Works.

**Boston & Maine Railroad #3710, P-4a, Lima, 1934.**



—Courtesy of Canadian Pacific Ry

**Canadian Pacific Light Pacific Type, Class G-5, Built at Angus Shops, 1944...**


—Courtesy of Baldwin Locomotive Works.

**Lehigh Valley R. R. #2006, K-1, Baldwin, 1906.**

the 1914 design, while the later locomotives are fitted with Type "E." The early group, apparently, originally carried a pressure of 205 pounds, but some are now carrying 225. All have piston valves and Walschaerts gear.

Engine 651 is of special interest as it is fitted with poppet valves operated by Walschaerts gear, and carries a pressure of 275 pounds. Number 652 has a boiler of the same dimensions as the 651, but the pressure is 260 pounds and piston valves are used. The 653 has piston valves, Walschaerts gear, and modified "Uniflow" cylinders, and carries a pressure of 325 pounds. This, the author believes, is the highest pressure yet carried in a locomotive boiler having a stay-bolted firebox.

These Delaware & Hudson locomotives are "semi-streamlined" in appearance, with neat lines and piping and accessories concealed as far as possible. Certain features of the design are suggestive of British practice.

The leading dimensions of representative hard-coal burning Pacific type locomotives are given in Table IV.

Mention has previously been made of the fact that many Pacific type locomotives, still engaged in heavy main line service, are meeting conditions far more difficult than those existing at the time they were built. This is particularly true in the case of certain locomotives that have been partly rebuilt and fitted with improved fuel and labor saving devices. One of the most notable cases of this kind is Pennsylvania locomotive number 5399, a Class K4s which, several years ago, was fitted with the Franklin system of steam distribution using poppet valves. Whereas the original locomotive of this class, which was hand-fired, developed a maximum of 3,200 indicated horsepower, engine 5399, equipped with a stoker and poppet valves, has developed 4,267 horsepower at a speed of 75 miles an hour, when cutting off at 30 per cent. In service between Crestline, Ohio, and Chicago, where grades are light and high speeds can be maintained, it has proved its ability to handle many trains which formerly had to be double-headed in order to make the time. Further development work has also been done on other locomotives of this group, with promising results.

The Erie Railroad, in 1941, carried out a notable rebuilding program with 11 Pacific type locomotives which had originally been built by The Baldwin Locomotive Works in 1923. The locomotives, as built, were similar in general design to the U. S. R. A. heavy Pacific type. In rebuilding them, the principal new features applied were: One-piece cast steel beds with integral cylinders, and with the guides supported entirely from the bed casting; Boxpok driving wheel centers; new Baker valve gear with needle bearings; a booster on the rear truck; and new tenders, having capacity for 16,000 gallons of water and 24 tons of coal. Some of the locomotives in the group were also fitted with roller bearings on the leading truck, driving and trailer axles. These engines are used on through passenger service between Jersey City, New Jersey, and Marion, Ohio, a run of 830 miles.

Another interesting case of rebuilding is found on the Alton Railroad, where ten Pacific type locomotives, originally built by the American Locomotive Company in 1914, have had their capacity and efficiency

greatly improved by modernization. The urgent need for additional power, together with the inability to secure new locomotives, prompted the Alton to rebuild the locomotives. In 1939, the engines had been equipped with stokers and new grates; the boiler pressure had been raised from 200 to 220 pounds, and the piston valve diameter reduced from 15 to 12 inches. The changes recently made include the application of feed-water heaters, new superheaters of improved design, thermic syphons in the firebox, and automatic foameters. Whereas when the locomotives were new, their regular job was to handle seven steel cars between Chicago and St. Louis on a schedule of 8 hours for the 282-mile run, they are now capable of handling 14 cars on a schedule of 5 hours 50 minutes. Undoubtedly the seven cars originally hauled did not represent the full capacity of the locomotive at that time, while the present 14-car trains are practically the maximum that can be moved on schedule. Comparing one of the fully modernized locomotives with another as improved in 1939, the maximum horsepower developed has been increased from 2,364 to 2,824, with a reduction in pounds of coal per car mile of almost 20 per cent, and an increase in water evaporated per pound of coal of about 11 per cent. The modernization of these ten locomotives has resulted in a fuel saving amounting to approximately $100,000 annually.

Four tables are presented with this article. The first gives particulars of early Pacific type locomotives using saturated steam; the second, of superheated locomotives built up to 1919, when the U. S. R. A. locomotives appeared; the third, of locomotives subsequently built, and the fourth, of locomotives built for the anthracite roads. The list is by no means complete, but it is sufficiently comprehensive to indicate the variety of designs that have been produced. The Pacific type has done —and is still doing—notable work, and has been singularly successful, not only in this country, but also throughout the world.

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*Bibliography:* The author's personal recollection covers practically the entire history of the Pacific type to date, and he has been familiar with many of the locomotives described. Information has been obtained from such publications as Railway Age and Railway Mechanical Engineer (and their predecessors); also from Railway Review, and the various editions of the Locomotive Cyclopedia. The locomotive builders have been generous in supplying photographs, and the author is indebted to Mr. Clinton T. Andrews, of Easton, Pennsylvania, who kindly furnished information on the history of Lehigh Valley locomotive 444, the *Duplex,* and to Mr. M. C. M. Hatch, for interesting data regarding some of the hard-coal burners.

## TABLE I
## PACIFIC TYPE LOCOMOTIVES USING SATURATED STEAM
## BUILT 1902-1910

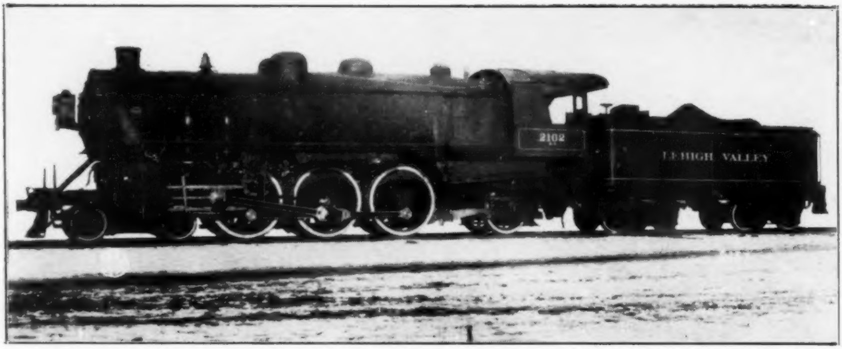
| *Road* | *Company's Class* | *Date* | *Builder* | *Cylinders* | *Drivers* | *Steam Pressure* | *Grate Area* | *Heating Surface* | *Weight on Drivers* | *Weight Total Engine* | *Tractive Force* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Missouri Pacific | | 1902 | Am. Loco Co. | 20x26 | 69 | 200 | 42.4 | 2953 | 120,000 | 173,000 | 25,600 |
| Chesapeake & Ohio | F-15 | 1902 | Am. Loco Co. | 22x28 | 72 | 200 | 47.0 | 3533 | 130,500 | 190,000 | 32,000 |
| Chicago & Alton | I-1 | 1903 | Baldwin | 22x28 | 73§ | 220 | 54.0 | 4050 | 134,900 | 219,500 | 34,870 |
| St. Louis & San Fran. | | 1904 | Baldwin | 20x26 | 69 | 200 | 43.3 | 2863 | 114,890 | 190,970 | 25,600 |
| Union Pacific‡ | P | 1904 | Baldwin | 22x28 | 77 | 200 | 49.5 | 3053 | 141,290 | 222,570 | 30,000 |
| C. M. & St. Paul | F-2 | 1905 | Railway Co. | 23x26 | 72 | 200 | 35.8 | 3382 | 142,000 | 218,000 | 32,500 |
| C. R. I. & Pacific | P-32 | 1905 | Am. Loco. Co. | 22x26 | 69 | 200 | 44.8 | 3354 | 133,800 | 206,000 | 31,000 |
| Ore. Ry. & Nav. Co.* | | 1905 | Baldwin | 17&28x28 | 77 | 200 | 49.5 | 3055 | 143,600 | 231,300 | 28,000 |
| A. T. & Santa Fe* | | 1905 | Baldwin | 17&28x28 | 73 | 220 | 53.4 | 3595 | 151,900 | 226,700 | 32,800 |
| Baltimore & Ohio | P | 1906 | Am. Loco. Co. | 22x28 | 74 | 225 | 56.2 | 3414 | 150,500 | 229,500 | 35,000 |
| Northern Pacific* | | 1906 | Am. Loco. Co. | 16½&27½x26 | 69 | 200 | 43.5 | 2909 | 157,000 | 240,000 | 30,346 |
| Chi. Bur. & Quincy | S-1 | 1906 | Baldwin | 22x28 | 74 | 210 | 55.0 | 3922 | 151,290 | 230,940 | 32,760 |
| Pennsylvania Lines | K-28 | 1907 | Am. Loco. Co. | 24x26 | 80 | 205 | 61.8 | 4448 | 182,000 | 273,600 | 32,700 |
| L. S. & Mich. Sou. | | 1907 | Am. Loco. Co. | 22x28 | 79 | 200 | 56.3 | 4195 | 170,700 | 261,500 | 29,200 |
| Chicago & Alton | I-4 | 1908 | Baldwin | 23x28 | 73 | 200 | 33.5 | 3927 | 146,500 | 243,200 | 34,500 |
| Chicago & Alton | I-5 | 1909 | Am. Loco. Co. | 23x28 | 80 | 200 | 49.5 | 4071 | 149,500 | 248,000 | 31,475 |
| C. M. & St. Paul | F-4 | 1910 | Railway Co. | 23x28 | 69 | 200 | 48.8 | 3910 | 160,100 | 248,800 | 36,500 |
| Chic. & N. Western | E | 1910 | Am. Loco. Co. | 23x28 | 75 | 190 | 53.0 | 4366 | 151,000 | 245,000 | 31,900 |
| Pennsylvania R. R. | K-2 | 1910 | Railroad Co. | 24x26 | 80 | 205 | 55.4 | 4629 | 185,900 | 278,800 | 32,700 |

* Balanced Compound.
‡ Also built with 80" Drivers; Tractive Force, 31,900 lbs. (Class I-2).
§ Associated Lines Standard Pacific Type.

## TABLE II
## PACIFIC TYPE LOCOMOTIVES USING SUPERHEATED STEAM BUILT PRIOR TO 1918

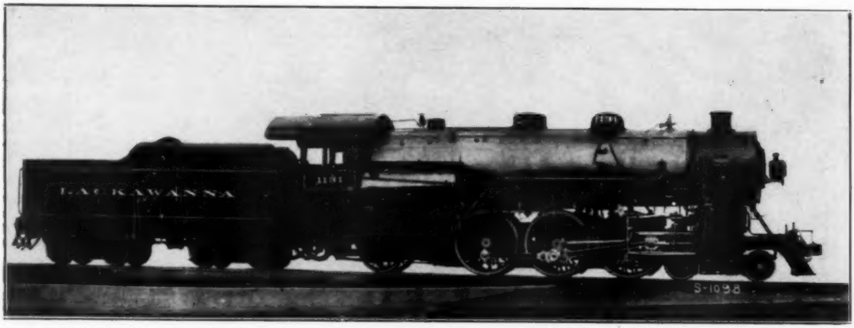
| *Road* | *Company's Class* | *Date* | *Builder* | *Cylinders* | *Drivers* | *Steam Pressure* | *Grate Area* | *Water Heating Surface* | *Superheating Surface* | *Weight on Drivers* | *Weight Total Engine* | *Tractive Force* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Erie | K-1 | 1905 | Am. Loco. Co. | 22½x26 | 74 | 200 | 56.5 | 3321 | 763 | 149,000 | 230,500 | 30,000 |
| A. T. & Santa Fe | | 1906 | Baldwin | 25x28 | 73 | 160 | 49.5 | 3392 | 759§ | 140,400 | 232,750 | 32,640 |
| Great Northern | H-4 | 1909 | Baldwin | 26x30 | 73 | 150 | 53.3 | 3137 | 641 | 165,220 | 248,970 | 35,400 |
| Northern Pacific | Q-4 | 1909 | Baldwin | 26x26 | 69 | 160 | 43.5 | 2438 | 505 | 142,200 | 238,000 | 34,700 |
| C. B. & Quincy | S-2 | 1910 | Baldwin | 25x28 | 69 | 160 | 55.0 | 3010 | 925 | 153,100 | 236,100 | 34,500 |
| A. L. Co. #50,000* | | 1911 | Am. Loco Co. | 27x28 | 79 | 185 | 59.8 | 4056 | 897 | 172,500 | 269,000 | 40,600 |
| New York Central | K-3 | 1911 | Am. Loco Co. | 23½x26 | 79 | 200 | 56.5 | 3424 | 765 | 171,500 | 269,000 | 30,900 |
| Pennsylvania R. R. | K-29S | 1911 | Am. Loco Co. | 27x28 | 80 | 200 | 66.1 | 4625 | 988 | 197,800 | 317,000 | 43,300 |
| New York Central | K-11C | 1912 | Baldwin | 26x26 | 69 | 180 | 56.5 | 3770 | 1013 | 168,300 | 267,200 | 38,950 |
| St. Louis - San Fran. | | 1912 | Am. Loco. Co. | 26x28 | 69 | 175 | 50.9 | 3676 | 759 | 158,000 | 260,500 | 40,800 |
| B. R. & Pittsburgh | | 1912 | Am. Loco. Co. | 24½x26 | 73 | 200 | 56.5 | 3635 | 757 | 163,500 | 258,000 | 36,300 |
| Erie | K-2 | 1913 | Lima | 27x28 | 79 | 185 | 66.7 | 3810 | 895 | 176,000 | 287,000 | 40,600 |
| N. C. & St. Louis | K-2-A | 1913 | Baldwin | 25x28 | 72 | 190 | 66.7 | 3823 | 842 | 165,500 | 259,800 | 39,300 |
| Chesapeake & Ohio | F-16 | 1913 | Baldwin | 27x28 | 73 | 185 | 59.6 | 3755 | 879 | 179,900 | 282,000 | 44,000 |
| Pennsylvania Lines | K3S | 1913 | Baldwin | 26x26 | 80 | 205 | 55.4 | 3670 | 791 | 196,300 | 293,600 | 38,280 |
| Pennsylvania R. R. | K4S | 1914 | Railroad Co. | 27x28 | 80 | 205 | 69.9 | 4041 | 943 | 201,830 | 308,890 | 44,460 |
| Union Pacific | | 1914 | Lima | 25x28 | 77 | 200 | 70.3 | 3986 | 895 | 164,100 | 273,500 | 38,600 |
| A. T. & Santa Fe‡ | 3500 | 1914 | Baldwin | 17½&29x28 | 73 | 210 | 58.0 | 3475 | 619 | 165,100 | 277,700 | 33,350 |
| C. B. & Quincy | S-3 | 1915 | Baldwin | 27x28 | 74 | 180 | 58.7 | 3364 | 751 | 169,700 | 266,400 | 42,200 |
| N. Y., N. H. & H. | I-4 | 1916 | Am. Loco Co. | 26x28 | 79 | 200 | 59.2 | 3315 | 776 | 165,000 | 266,000 | 40,800 |
| St. Louis - San Fran. | P-45 | 1917 | Baldwin | 26½x28 | 73 | 200 | 63.5 | 4200 | 996 | 188,800 | 309,000 | 45,800 |

* Sold to Erie Railroad; Road No. 2509, Class K-3.
‡ Balanced Compound.
§ Smokebox Superheater.



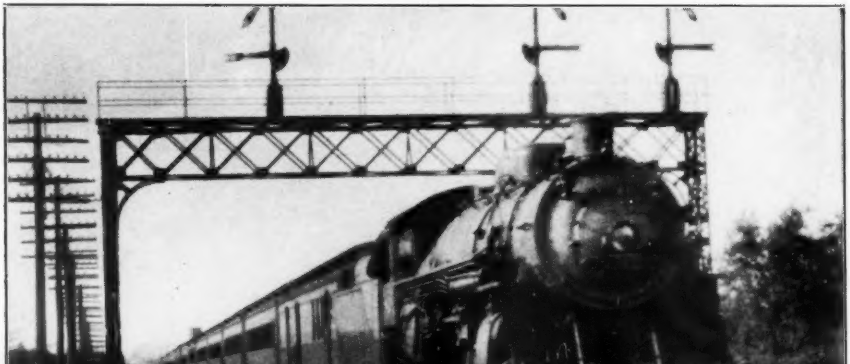
—Courtesy of Baldwin Locomotive Works.

**Lehigh Valley R. R., #2102, K-5, Baldwin, 1916.**



—Courtesy of American Locomotive Company.

**D. L. & W. #1131, N-6, A. L. Co., 1915.**



**Train No. 6, the Lackawanna Limited, passing Pocono Summit, Pa., August 17, 1927. John Draney at the throttle—Engine 1140. Photo by C. Linsley, using the author's camera. Speed 60 M. P. H.**

## TABLE III
## PACIFIC TYPE LOCOMOTIVES BUILT AFTER 1918

| Road | Company's Class | Date | Builder | Cylinders | Drivers | Steam Pressure | Grate Area | Water Heating Surface | Superheating Surface | Weight on Drivers | Weight Total Engine | Tractive Force |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U. S. R. A. (B. & O.) | P-5 | 1919 | Baldwin | 25x28 | 73 | 200 | 66.7 | 3341 | 794 | 167,100 | 275,770 | 40,750 |
| U. S. R. A. (Erie) | K-5 | 1919 | Baldwin | 27x28 | 79 | 200 | 70.8 | 3824 | 882 | 197,000 | 306,000 | 43,900 |
| Southern Pacific | P-8 | 1921 | Baldwin | 25x30 | 73½ | 200 | 70.4 | 3352 | 867 | 180,000 | 297,800 | 43,600 |
| N. Y. C. & St. Louis | | 1922 | Lima | 22½x26 | 73 | 200 | 50.2 | 3059 | 768 | 148,500 | 245,000 | 30,700 |
| Mo. Kansas & Texas | H-3-d | 1923 | Lima | 25x28 | 73 | 200 | 57.5 | 3771 | 880 | 167,000 | 273,000 | 40,750 |
| Chic. & East. Ill. | K-3S | 1923 | Lima | 27x28 | 79 | 200 | 70.8 | 4289 | 1141 | 189,000 | 306,000 | 43,900 |
| Chic. & N. Western | E-2 | 1923 | Am. Loco. Co. | 26x28 | 75 | 210 | 63.1 | 3268 | 882 | 175,500 | 292,000 | 45,000 |
| Missouri Pacific | | 1924 | Am. Loco. Co. | 27x28 | 73 | 185 | 66.8 | 3507 | 980 | 180,500 | 288,000 | 44,000 |
| Lou. & Nashville | K-7 | 1925 | Am. Loco. Co. | (3) 22½x28 | 73 | 190 | 66.8 | 3435 | 933 | 177,000 | 295,000 | 47,000 |
| Boston & Albany | | 1925 | Am. Loco. Co. | 26x28 | 75 | 200 | 67.8 | 4192 | 1163 | 185,500 | 298,000 | 52,600* |
| Southern | | 1926 | Am. Loco. Co. | 27x28 | 73 | 200 | 70.5 | 3689 | 905 | 182,000 | 304,000 | 47,500 |
| Atlanta & W. Point | P | 1926 | Lima | 27x28 | 73 | 200 | 70.8 | 3669 | 994 | 192,500 | 303,500 | 47,500 |
| Chesapeake & Ohio | F-19 | 1926 | Am. Loco Co. | 27x28 | 73 | 200 | 80.3 | 4239 | 1213 | 200,000 | 331,500 | 47,500 |
| R. F. & Potomac | | 1927 | Baldwin | 27x28 | 75 | 210 | 75.8 | 4175 | 1078 | 205,300 | 332,600 | 48,580 |
| Baltimore & Ohio | P-7 | 1927 | Baldwin | 27x28 | 80 | 230 | 70.3 | 3846 | 932 | 201,000 | 326,000 | 50,000 |
| Grand Trunk Western | K-4-b | 1929 | Baldwin | 25x28 | 73 | 215 | 66.7 | 3418 | 789 | 184,540 | 299,330 | 40,700‡ |
| Pennsylvania R. R. | K-5 | 1929 | Railroad Co. | 27x30 | 80 | 250 | 69.9 | 4285 | 1634 | 207,600 | 318,700 | 54,675 |
| C. St. P. M. & Omaha | E-3 | 1930 | Am. Loco. Co. | 25x28 | 75 | 260 | 70.2 | 4295 | 2017 | 210,000 | 347,000 | 64,400* |
| Boston & Maine | P-4-a | 1934 | Lima | 23x28 | 80 | 260 | 66.9 | 3848 | 966 | 209,500 | 339,200 | 52,800* |
| Canadian Pacific | G-5 | 1944 | Railway Co. | 20x28 | 70 | 250 | 45.6 | 2576 | 744 | 150,000 | 231,000 | 34,000 |

* With Booster.
‡ Limited Cut-off.

## TABLE IV
## PACIFIC TYPE LOCOMOTIVES BUILT FOR THE ANTHRACITE ROADS

| Road | Company's Class | Date | Builder | Cylinders | Drivers | Steam Pressure | Grate Area | Water Heating Surface | Superheating Surface | Weight on Drivers | Weight Total Engine | Tractive Force |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lehigh Valley§ | | 1886 | Railroad Co. | 20x24 | 62 | 160 | 62.0 | 1848 | ........ | 90,000 | 138,000 | 21,040 |
| Lehigh Valley | K-1 | 1905 | Baldwin | 22x28 | 76½ | 200 | 80.0 | 3853 | ........ | 159,180 | 238,380 | 30,115 |
| Lehigh Valley | K-2½ | 1913 | Railroad Co. | 25x28 | 77 | 215 | 87.0 | 3744 | 812 | 161,940 | 262,160 | 41,600 |
| Lehigh Valley | K-5 | 1916 | Baldwin | 27x28 | 73 | 205 | 75.0‡ | 4103 | 980 | 197,200 | 301,500 | 48,800 |
| Lehigh Valley | K-5-A | 1919 | Baldwin | 27x28 | 73 | 205 | 95.2 | 4116 | 980 | 204,560 | 311,900 | 48,800 |
| Lehigh Valley | K-6-B | 1924 | Am. Loco. Co. | 25x28 | 77 | 215 | 75.3‡ | 3285 | 845 | 181,000 | 291,000 | 51,900* |
| Read Company | G-1-sa | 1916 | Railway Co. | 25x28 | 80x | 220 | 94.5 | 2983 | 621 | 176,925 | 273,600 | 40,900 |
| Read Company | G-2-sa | 1926 | Baldwin | 25x28 | 80 | 230 | 94.5 | 3045 | 745 | 192,540 | 306,360 | 42,800 |
| Central R. R. of N. J. | G-1S | 1918 | Baldwin | 26x28 | 79 | 210 | 94.8 | 3757 | 816 | 181,400 | 291,400 | 42,770 |
| Central R. R. of N. J. | G-3S | 1927 | Baldwin | 26x28 | 79 | 230 | 84.3‡ | 3849 | 791 | 197,660 | 326,470 | 46,840 |
| Central R. R. of N. J. | G-4S | 1930 | Baldwin | 26x28 | 74 | 240 | 84.3‡ | 3591 | 1000 | 205,900 | 333,830 | 52,180 |
| D. L. & W. | N-1 | 1912 | Am. Loco. Co. | 25x28 | 73 | 200 | 94.5 | 3844 | 821 | 179,500 | 284,000 | 40,700 |
| D. L. & W. | N-3 | 1913 | Am. Loco. Co. | 25x28 | 69 | 200 | 58.0 | 3990 | 868 | 186,500 | 286,000 | 43,100 |
| D. L. & W. | N-6 | 1915 | Am. Loco. Co. | 27x28 | 73 | 200 | 91.0 | 3691 | 808 | 197,300 | 305,500 | 47,500 |
| D. L. & W. | N-10 | 1922 | Am. Loco. Co. | 25x28 | 79 | 210 | 95.0 | 3174 | 645 | 191,000 | 301,000 | 39,500 |
| Delaware & Hudson | P | 1914 | Am. Loco. Co. | 24x28 | 73 | 205 | 99.3 | 3896 | 840 | 192,500 | 295,000 | 38,500 |
| Delaware & Hudson | P-1 | 1930 | Railroad Co. | 22x28 | 73 | 275 | 87.0 | 3162 | 1495 | 191,000 | 300,000 | 43,600 |

§ Strong's patented cylinders, valve gear and boiler. Two cylindrical, corrugated fireboxes.
* Including booster.
‡ Designed for bituminous coal.
x Class G-1-s-b has 74" drivers; tractive force, 44,200 lbs.

# Annual Meeting

The Annual Meeting of this Society was held in the Hotel Bellevue, Beacon St., Boston, Massachusetts on May 5th, 1946, with Directors Becker, Fisher, Jacobs, Merrill and Walker from Boston, present and Messrs. Gaynor, Hungerford, Schmid and Whitaker present from New York and Miss Henrietta Carter of New York, guest.

The reports of the officers, as printed in the annual report were approved. There was considerable discussion as to the form of celebration for our 25th anniversary and it was again decided to have a dinner in New York City, either in the months of October or November, prior to Thanksgiving. In addition to Messrs. Hungerford, Gaynor and Schmid Mr. Rogers E. M. Whittaker was appointed a member of this committee.

Mr. Hungerford reported progress on the railroad museum project and we are hopeful that something can be accomplished along these lines.

It was voted to change the title of Assistant Secretary to that of Financial Secretary and Warren Jacobs was appointed to investigate the cost of restoring the marker of the grave of Asa R. Porter.

The following gentlemen were elected to serve as Directors of this Society until May, 1947; George P. Becker, Dr. Arthur H. Cole, Charles E. Fisher, Walter R. Fogg, Edward Hungerford, Warren Jacobs, John W. Merrill, Robert C. Schmid, Harold S. Walker and Sidney Withington.

Immediately following the Annual Meeting, the directors elected the following to serve as officers until the next Annual Meeting: Charles E. Fisher, President; Sidney Withington, Vice President; Warren Jacobs, Secretary; Harold S. Walker, Financial Secretary and George P. Becker, Treasurer.

The meeting adjourned at 4:00 P. M.

May 8th, 1946. WARREN JACOBS, Secretary.

# New Books

A RAILROAD FOR TOMORROW, by Edward Hungerford, 323 pages, 9x6, illustrated. Bound in cloth. Published by the Kalmbach Publishing Co., Milwaukee (8), Wisconsin. Price $5.00.

Our own "Ed" Hungerford has indulged in a whimsy of what the railroads of this country will be like in the year of 1960. In the opinion of the author, our railroads should go into the post-war period with some highly modern plan for the future, otherwise Washington will have a plan and that will be government ownership and all that that involves. The story is in the form of a narrative—a visitor from England is told the various steps by which this is accomplished.

The pattern, in brief, is a consolidation of 118 "Class A" roads into one big railroad—the United States Railroad. It is made up of 21 operating divisions with a central organization handling the legal, financial, design of equipment, personnel, public relations, etc. At the head is the director general, the hero of Mr. Hungerford's story, appointed by the President of the United States. Affairs are administered by a 42-man self-perpetuating board of directors, made up of 21 "presidents" of the operating units and an equal number of public representatives including the six heads of the railway unions, the president of the U. S. Chamber of Commerce and of the National Association of Shippers' Advisory Boards, the Speaker of the House, the Vice President of the United States and the chairman of "the interstate commerce committee"—but, no bankers.

"Full crew" and train limit regulations, "featherbedding" and the complicated old time agreements with the brotherhoods would be abolished. Trucks would be limited to 5 tons in weight, no trailers and restricted to 200 miles or less where rail service is available. The railroads would not handle freight under 100 miles if it could be handled by truck.

In setting up his 21 operating units the author has followed his own plan of consolidation. It would result in the abandonment of many miles of railroad, it would use more efficiently what is already built. He would build the line from Easton, Pa., to Pittsburgh, once advocated by Mr. L. F. Loree and he would combine the best sections, with the easiest grades, of the Boston & Albany and Boston & Maine roads to give New England a better outlet to the west. He would build a new "Grand Central West" to New York's passenger terminals, providing a loop under the Hudson and bring the New Jersey lines into it. Boston would have a new station on a new site near the Charles River. The valuable property of the B. & A., where the Exeter St. car yards now are located would be occupied by valuable real estate. The terminals in Chicago would be re-arranged and a new trans-bay bridge would bring trains from the north and east into San Francisco. Passenger schedules have been worked out and through trains run from New York to Fairbanks, Alaska and to Mexico City.

Now, whether this will all take place before or after 1960 and according to the plans set forth by the author—that is impossible to state. Mr. Hungerford is correct in approaching the problem for the reason he states—either the railroads themselves must have a plan or else our

government will have a less agreeable one. Since the book has been printed the author has seen the inauguration of through car service from New York past and through Chicago and St. Louis. He has also witnessed a determination on the part of the roads entering Chicago to alleviate the terminal problem in that city. With this much already started other things may come in the future—the next decade will be of decided interest and this book, if it only causes some consideration and action on the problems involved, will have amply served its purpose. It is well worth our serious consideration.

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HEADLIGHTS AND MARKERS, edited by Frank P. Donovan, Jr., and Robert Selph Henry, 406 pages, 9x6. Bound in cloth. Published by Creative Age Press, New York, N. Y. Price $2.75.

At the front of the train is the headlight, at the rear the markers—anything can happen between the two and in this case it is mainly enjoyment to the reader. The book is made up of selected short stories of well known authors. They range from a stirring Civil War tale to one that took place in World War II. The contents include "The Yellow Mail Story" and "The Road Master's Story" by Frank H. Spearman; "A Little Action" by Harold Titus; "The Stolen Railroad Train" by Marquis James; "An Engineer's Christmas Story" by John Alexander Hill; "Run to Seed" by Thomas Nelson Page; "The Night Operator" by Frank L. Packard; "A Ghost Train Illusion" by Cy Warman; "The Angel of Canyon Pass" by Charles W. Tyler; "Huey, the Engineer" by Jesse Stuart; "The Berth of Hope" by Octavus Roy Cohen; "Mrs. Union Station" by Doug Welch; "Remarks; None" by William Wister Haines; "Wide Open Throttle" and "Counterbalance" by A. W. Somerville and "Smart Boomer" and "Priority Special" by Harry Bedwell. The editors have shown keen judgment in selecting these stories for their interest, variety and literary merit. We can only regret the book was not twice the size with twice as many stories but perhaps we can look forward to another volume. Whether you have read them before, as I have, you will enjoy reading them again and welcome the opportunity of owning them in book form.

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TRAINS ALBUM OF PHOTOGRAPHS NUMBER 12—Santa Fe Railway. Published by Kalmbach Publishing Co., Milwaukee (3), Wisconsin. Price $1.00.

Trains Magazine a few years ago commenced the publication of albums, made up chiefly of photographs on our railroads. Book 1 was devoted to the Eastern Railroads; Book 2 to Far Western Railroads; Book 3 to Midwestern Railroads; Book 4 to the Colorado Railroads; Book 5 to the Southern Railroads; Book 6 to our New England Railroads; Book 7 to the Electric Railways; Book 8 to the Pennsylvania R. R.; Book 9 to the New York Central R. R.; Book 10 to Modern Steam Locomotives; Book 11 to the Southern Pacific Lines and Book 12 to the Santa Fe Railway. Book 13 will be devoted to the Baltimore & Ohio R. R.; Book 14 to the Erie R. R.; and Book 15 to the Great Northern Ry.

These books sell for $1.00 per copy, the views include both action and stills, taken by many of our best rail photographers and they will form a valuable addition to any rail "fan" or rail historian's library. Printed on a good quality of paper with laminated plastic cover they tell in an interesting fashion the operations of our several railroads.

# Frank Fuller Fowle

Frank Fuller Fowle passed away in his home at Winnetka, Illinois on January 18th, 1946. The end came quickly and quietly—heart trouble. To those of us who knew him, that enjoyed his comradeship, we have lost a friend.

Born in San Francisco, Cal., Nov. 29, 1877, son of Edward Osborne and Helen (Fuller) Fowle, he entered and graduated from the Massachusetts Institute of Technology in 1899. For those who desire a list of his accomplishments, you are referred to the 1941 edition of "Who's Who in Engineering." His achievements made but little difference to his friendships and he was an expert in electrical and mechanical engineering and the head of the firm bearing his name.

If the boy makes the man, and I can't help but feel that it does, then these few words may be of interest. For two summers the writer with his mother and sister spent their vacations on the Fuller farm at Hancock, New Hampshire. I do not recall his father, but his mother was as fine a woman as any boy could have and "Grandpa" Fuller, as he was affectionately called by everyone, was a fine sterling character of that rock-ribbed granite state. It was these two who influenced his life. "Grandpa" Fuller never encouraged the gift of the useless toys that are given children but if Frank wanted the wherewithal to make them, he would give him all kinds of encouragement.

Although he was a good ten years my senior, he probably tolerated my companionship and, I daresay fearfully allowed me to play with his home made railroad. At the end of our second summer our paths diverged sharply and were not brought together again until the formation of this Society. For the last decade, save for the war years, one day in the month of November, when Frank and his wife came east, was spent in visiting old scenes and talking over old times on the old place at Hancock.

We would retrace in our minds the layout of the little railroad, rails made of sticks of wood, sawed off spools furnished the wheels, cars made of wooden blocks, painted and decorated, engines made of the same thing, but the masterpiece was a bridge over an imaginary river. "I used to go over to the store, count the cigars in the different boxes and estimate when I'd get that box to add to my railway," Frank told me several times.

Here were the ice tongs that he forged in the local smith shop after his course in forge work, welded so that the joints were almost impossible to find. He constructed a windmill, set atop the barn with the shaft through the roof to drive his generator. The latter was a home made affair but the running of the shaft through the roof was a "dickens of a job." Other articles, too numerous to mention here were dug out during these visits; their story told and perhaps the years slipped away from us both. But all of these articles showed the wisdom of "Grandpa" Fuller in making his grandson learn to contrive in their construction.

And if his product may be judged by one of us, both as a man and what he created while he was here, then his mother and his grandfather have every reason to be proud of him and his two sons may share a noble heritage.

I am sure that he rests quietly now beside his wife who passed away only a short time before him, both beside the lake where we boys used to play. And not far away, that peak of solid granite, old Mount Monadnock, eternally watches over all. Yes, those of us that enjoyed the comradeship and companionship of Frank Fowle will always miss him, he left his mark in the engineering field and his training and his success should serve as an inspiration to Young America.

## In Memory Of

WILLIAM J. COUGHTRY
Life Member
Nutley, New Jersey
who died on March 14th, 1946.

RICHARD DAY
Annual Member
132 Rutherford Place
North Arlington, New Jersey
who died on March 15th, 1946.

## INDEX TO ARTICLES APPEARING IN BULLETINS 66, 67, 67A AND 68.



Bulletin 67 is devoted entirely to a history of the motive power of the Reading Co., together with complete rosters of their locomotives.

Bulletin 67A is devoted to the narrow gage lines in the vicinity of Durango, Colo., as found by the author on his visits the past two years. For this reason, no page number is given.